ERDC/CERL SR-01-6

Construction Engineering Research Laboratory

US Army Corps of Engineers®
Engineer Research and Development Center

Corporate Lessons Learned (CLL) System

System Decision Paper

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June 2001

Foreword

This study was conducted for Office of the Chief of Engineers (OCE) under Reimbursable Funding No. W74RDV00872555, “Corporate Lessons Learned”; Work Unit No. V48, “Corporate Lessons Learned Documentation.” The technical monitor was Wilbert Barrios, CECI-ZA.

The work was performed by the Engineering Processes Branch (CF-N) of the Facilities Division (CF), Construction Engineering Research Laboratory (CERL). The CERL Principal Investigator was E. William East. The technical editor was William J. Wolfe, Information Technology Laboratory. Dr. Michael P. Case is Chief, CEERD-CF-N, and L. Michael Golish is Chief, CEERD-CF. The associated Technical Director was William D. Goran, CEERD-CV-T. The Acting Director of CERL is Dr. Alan W. Moore.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Director of ERDC is Dr. James R. Houston and the Deputy to the Commander is A.J. Roberto, Jr.

Contents

I SDP Transmittal Memorandum

MEMORANDUM FOR: Chief of Engineers,
ATTN: CECI-ZA / Mr. Wilbert Berrios,
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SUBJECT: Transmittal of System Decision Paper for Corporate Lessons Learned (CLL) system

The Engineer Research and Development Center's Construction Engineering Research Laboratory is pleased to submit the attached LCMIS documentation for the Corporate Lessons Learned (CLL) System. The attached System Decision Paper is for a combined Milestone 1 (Demonstration and Validation Phase) and Milestone 2 (Development Phase) of CLL. Attached, as Appendix A to this document, is the Economic Analysis for CLL.

When approved, the completion of the CLL development effort will provide the Corps of Engineers with a corporate level method to capture, review, approve, and reuse lessons learned across a variety of legacy information systems as well as have this capability to incorporated within future ISs. The financial importance of a corporate wide approach to lessons learned is clearly shown in the attached Economic Analysis. Lessons already generated with the first Design Quality application using a prototype CLL are estimated to save Seattle District $2.8M over the next seven (7) years. By making these lessons available to the entire Corps with a completed CLL, anticipated saving on these lessons will grow to $52.8M over the next seven (7) years.

The remaining two-year completion development timeline is presented within the SDP as well a breakout of the funding requirements (1st year $200K, 2nd year $200K). The Savings to Investment Ratio (SIR) for this effort is 141 and the Discounted Payback Period (DPP) is 2 years.

System maintenance expenditures after development are anticipated at $200K per year. The resources necessary to integrate LL functionality within existing ISs should be drawn directly from their operating budgets as priority dictates. The cost to integrate a legacy IS with CLL is estimated at $200K per IS.

E. William East
CLL System Manager
Engineering Process Branch
Construction Engineering Research Laboratory

II Synopsis

A. Functional Proponent (FP)

HQ USACE / CECI

B. Project Name

Corporate Lessons Learned (CLL)

C. ACAT Category and Milestone

ACAT IV-B Combined Milestone 1 Demonstration and Validation Phase and Milestone 2 Development Phase.

D. System Manager (SM)

Mr. E. William East, CEERD-CF-N

E. Business Process Analysis

A comprehensive review and analysis of the design quality business process was conducted during the period FY95-98. Information gained from these activities was used to identify methods for improving design quality and was utilized to develop the Corporate Lessons Learned (CLL) concept.

The initial concept of capturing LL during a business process was identified in 1995 with the development of the Reviewer's Assistant System[*]. This specific application dealt with how to automatically capture LL during a design review process by using a machine learning technique.

How to create and abstract LL during the design process was further developed in 1996 by a group of papers presented to an American Society of Civil Engineering conference[†]. Also during this period the Construction Industry Institute published a research report titled Modeling the Lessons Learn Process[‡]. This document identified the benefits of LL, reviewed current practices, and identified existing systems (including COE efforts). Many CLL identified concepts were supported by this document.

Also during this early review of the design quality business process, a prototype system was developed to demonstrate how during a project's life cycle knowledge and experience could be captured, processed, and disseminated within an organization by the use of the world-wide-web. The focus of the ef-

[*] The Reviewer's Assistant System: System Design Analysis and Description E. William East et al, USACERL Technical Report FF-95/09 April 1995.
[†] Creating and Abstracting Lessons-Learned from BCO Reviews, Bill East Chair et al, ASCE 1st Congress on Computing in Civil Engineering, Reston VA 01 Jan 1996.
[‡] Research Team 123, dated Draft August 2, 1996

fort was to use a geographically based interface to retrieve and disseminate related information. This effort clearly demonstrated how the world-wide-web could be used to support the design intent of the prototype CLL[*].

The requirements for an initial version of CLL were identified in 1997 and a prototype version of CLL was also developed. The requirements were published in 1998 as a technical report[†].

The initial CLL design requirements and prototype were reviewed internally and externally. The CERL CLL developer participated in the Department of Energy's Lessons Learned Society[‡] to further identify what approaches have, and have not been, successful at other government agencies. As part of a R&D project, two workshops were held in 1996/98 with Corps HQ, Division, District, and Resident Office personnel to further validate and refine the necessary requirement and approach of the lessons learned system. These findings were used to update the prototype CLL[§].

The above analysis and development efforts produced a CLL concept that was successfully reviewed at multiple levels. A Corps' employee from the Vicksburg District, on long-term training at Georgia Tech, verified that the prototype CLL was the most effective approach to lessons learned[**]. An interdirectorate task force created by the Corps' Board of Directors to review lesson learned approaches confirmed this opinion in 1997 and identified the CLL as the "best of breed' when compared with 47 other systems and approaches to lessons learned.

As a result of the Board of Directors review, in May 1998 the Chief of Engineers authorized a two-district test (Baltimore and Huntington) of CLL with a design quality application. Because of the success of the test at Baltimore and Huntington, the Office of Secretary of Defense identified the CLL system as a quality management "Best Practice" for Quality Management in December 1998.

An economic analysis of benefits of CLL to the Design Quality Business Process identified significant savings from the first application to be integrated with CLL. Re-use of lessons learned generated by the Design Review and Checking System (DrChecks) and stored in the Design Quality LL Repository at the Seattle District offer a savings potential of $2.8M to Seattle District during the next 7 years. The ability of Corps wide re-use of these les-

[*] The Use of Organizational Knowledge Within Public Works Engineering Construction and Maintenance Agencies , USACERL Technical Report 98/64, 01 Apr 98, Bill East et al.
[†] Design Review and Related Lessons Learned Systems , USACERL Technical Report, 01 Jan 1997, Bill East
[‡] U.S. Department of Energy Society for Effective Lessons Earned Sharing, April 1-2 1997
[§] Design Review and Related Lessons-Learned Systems in the U.S. Army Corps of Engineers, USACERL Conference Proceedings 97/71, April 1997, Bill East
[**] The Use of Organizational Knowledge Within Public Works Construction and Maintenance Agencies, ibid

sons provided by CLL, offers a corporate savings potential of $52.8M for these same lessons. The complete economic analysis is included in the Appendix.

F. Mission Need

The Corps, as service organization, continually strives to produce projects “better, cheaper, and faster” than the competition. To do this, the Corps must rapidly adopt new technologies that support competitive advantages. An example of this willingness to innovate is that since the successful initial test of CLL in 1998, approximately one-third (1/3) of the Corps’ districts have adopted and are paying for annual subscriptions to the prototype CLL. The adopting districts see this methodology has a way to both improve the direct execution of projects and also the business processes that enable project execution. CLL meets users needs with an effective lessons learned reuse processes that allows them to avoid repetitive mistakes and also provides a method to share good business practices.

The ultimate benefit of CLL is that it provides the capability for the Corps’ business processes to respond directly to customer specific and location specific criteria. Not only can Corps’ customers provide input to the CLL system but they will also have the ability to track how and when each item they submit gets translated into changes to Corps’ standard operating procedures or technical requirements.

Currently, some offices have stand-alone lessons learned databases associated with specific topics or specific technical subjects. Some of these knowledge repositories have the desirable feature of being integrated within the business process that uses this information like the Resident Engineer System (RMS). Other repositories are simply stand-alone databases, such as the Hazardous, Toxic and Radioactive Waste Center of Expertise Lesson Learned, which require users to visit an independent site to acquire information.

These systems are primarily operated and maintained by local champions who are often also the subject matter experts as well. The success or failure of these systems is driven by these individuals’ energy and commitment and to ensure system success. These champions must often dedicate full time to the capture, evaluation, and entering of lessons to “their” systems. Since these stand-alone systems are not fully integrated into the entire business process that produces the lesson information, the information has to be re-entered into these knowledge repositories. To reuse of this information, an interested party must first go to the site and then create a specific retrieval query against this knowledge repository. Since these “extra steps” are required of stand–alone systems, employees rarely exercise the opportunity to utilize the corporate knowledge that has been gathered. In addition, these local systems are extremely difficult and costly to maintain and administer. If the local champions of these systems depart, often the viability of the system as well as the information it contains is lost to the Corps.

Thus unless there is an easy-to-use method to both capture and apply lessons learned as people go about their daily business practices, the paper or electronic lessons will not be re-used. These problems are more difficult if multiple offices have related lessons learned databases on different topics. Even if the employee wanted to use the data, it is unlikely that they would know either about the existences of these repositories or be able to find the locations of all the relevant data sources. These issues have been all been directly address by design of CLL.

G. Mission Performance

In a large and distributed organization, such as the Corps of Engineers, similar projects are often completed by various teams composed of individuals with different historical experience levels. As a result, lessons learned by one team are often not readily or easily available to other teams and therefore must be re-learned at other sites. Without effective communication methods, recurring problems are inevitable given the breadth of customers, locations, and facility types that are included within the Corps program. By building an effective lessons learned sharing and reuse mechanism into users' daily business process, such problems will virtually disappear because the correct solution to the current problem can be easily identified, retrieved, and applied.

Allowing customers to participate in the identification of customer and location specific criteria will strengthen the bond between the Corps and its customers. The CLL, therefore, has the effect adding an increased capability for the Corps to be sure to meet custom specific requirements that does not existing in other facility delivery processes.

The initial application focus of CLL was the USACE Design Quality Business Area. The demonstrated success with this business area points to potential success offered by applying CLL to any business process. CLL can also collect needed information vertically and horizontally across staff efforts that support line activities.

Five new concepts are introduced with CLL:

Capture LL while doing work. The design concept of CLL is that a "submit" button is added to legacy programs that will allow capture of potential lessons will doing standard tasks.

Distributed Gate keeping. CLL routes suggested LL to local evaluators for approval (2 in Figure 1).

LL Registry. This is the sharing mechanism that allows employees to quickly find lessons learned stored in different forms and locations, referred to as repositories that relate to their current problem area. The registry can be viewed as the worldwide address book that identifies the locations of all repositories on all LL topics (3 in Figure 1).

Submission Locally and Nationally. This registry concept supports the local entry of lessons (1 in Figure 1), local approval of lessons (2), and retrieval of lessons by the Registry (3) for any user. Note that LL topics that are of a national level are retained at a national site (4) which are sometimes called a Center of Standardization (COS).

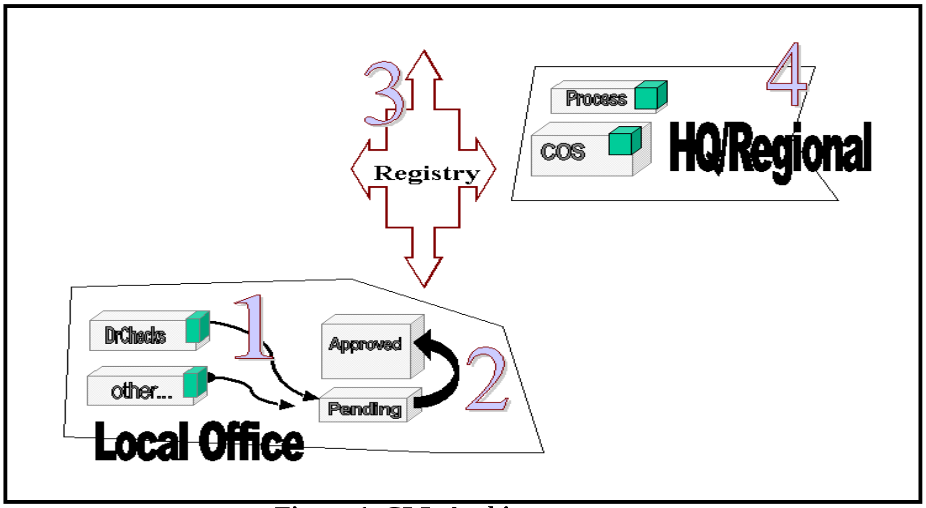

Figure 1. CLL Architecture.

Automatic Tracking and Follow Through. CLL extensively utilizes e-mail to inform LL submitters and evaluators on the status of submittal and approval activities. Process management reports are also available. Assignments and status reporting are automatic and require no external effort.

The CLL registry will be designed to adapt to changes in content and scope of local and national lessons learned repositories. Existing and new business processes or national lessons learned centers would be evaluated by the CECI to determine the benefit of inclusion in the CLL registry. If approved, the location and method for accessing these repositories will automatically transmitted to the CLL Registry. Repositories maybe updated or added over time and registry updates may be brought on-line automatically primarily by CLL software. An XML data exchange standard will be developed to allow the Registry to communicate with different repositories. This effort shall be started and completed during the second year of the development effort.

III Project Concept

A. Project Management

An Integrated Product Team (IPT) has been assembled from ERDC (CEERD-CF-N) and HQ USACE (CECI) to provide project oversight. This effort shall provide the backbone for the capture of CLL from other Information Systems (ISs). Proponents for these other ISs must take an active role in funding and oversight of the integration of CLL into “their” IS. Development of CLL and project management of the effort is being accomplished by CEERD-CF-N. Staffing of CLL approval and issues related to the linking to other ISs are the responsibility of proponents of the ISs with the advice and assistance of CECI.

B. Development Strategy

The evolutionary strategy was selected as the development methodology. This choice was made as it allowed the development of initial CLL components with the first software build prior to completion of the entire design. This limited focused approach allowed an initial prototype CLL build to support two COE Design Quality Business Practices: DrChecks and the Whole Barracks Renewal Program. DrChecks successfully demonstrated the concept of CLL 1 and 2 in Figure 1 (local collection, evaluation, and re-use of lessons). The Whole Barracks Renewal Program successfully demonstrated CLL 4 in Figure 1 (national collection, review, and re-use of lessons). The demonstrated CLL success with these two systems caused this approach to be recognized as the best conceptual method to follow in developing a corporate lessons learned system.

C. Acquisition Strategy

CLL will be developed by primarily by in-house COE resources with some contractor support during the FY00 effort of LCMIS document preparation and the following two-year development effort. The Engineering Research and Development Center's (ERDC) Construction Engineering Research Laboratory (CERL) will accomplish project management and development.

During the second development year (FY01), CERL will extend the first fully operational prototype CLL application (Design and Review Checking System (DrChecks)) into a corporate system during the first year of the development effort. A Registry will be developed to allow sharing of information between ISs.

The focus of the third development year (FY02) will be the development of the Data Exchange Format. This effort will allow the free and meaningful exchange of information between any legacy ISs.

Each proponent of an IS will be require to fund and manage a separated development effort to add a CLL component. Work required for this activity will include: (1) development of a local lesson collection capability (see 1 in Figure 1), (2) development of a local repository (see 2 in Figure 1), and (3) update of registry to accommodate the new IS (see 3 in Figure 1). Items 1, 2 and 3 must be funded from the application's IS budget. The framework of the CLL Registry to easily support new additions shall be programmed for and funded from the CLL development and operational budget during the second year.

D. Describe the target user system

Initial focus of CLL targets has been those IS directly involved with Design and Construction Quality. Currently DrChecks is the only application. A logical next candidate could be the Resident Management System (RMS). An information paper on applying CLL to RMS is under development. The final decision is the responsibility of IS managers who, acting with CECI will identify, plan, and program resources for the next application to be added to CLL. Other horizontally and vertically related ISs should also be evaluated to determine the benefits of being added to CLL.

IV Resource Management

A. CLL Membership in ITIPS.

CLL was added to ITIPS on 12 May 1998 and last updated on 15 Jul 1998

B. IS Life Cycle Cost Summary

1. Cost Summary:

Detailed development cost and time frames are presented on Table 1 below.

Table 1 LCIMS CLL Development Schedule and Cost

ACTIVITY	COST	TOTAL	STATUS	SOURCE
FY00				
Design Review LL (a)	-		Completed	(R&D)
LCMIS Documentation (b)	$50K		Completed	(CECI)
CLL Economic Analysis (c)	$55K		Completed	(CECI)
Map to Command Data Dictionary(d)	$45K		In progress	(CECI)
		$150K		
FY01				
CLL Registry revision (e)	$100K			(CECI)
Push Back Technology (f)	$100K			(CECI)
	$200K	$350K		
FY02				
Data Exchange Format/Process (g)	$100K			(CECI)
CLL Process Management Report (h)	$100K			(CECI)
	$200K	$550K		
IS Budget Funding Responsibility to Integrate with CLL				
FY03-FY10 (Cost per IS added to CLL)				
Add CLL Module (per IS)	$150K			IS Budget (i)
Update Repository (per IS)	$ 50K			IS Budget (i)
	$200K			per IS

Notes:

(a) The CLL module is currently included in the Design Review and Checking System (DrChecks). There are currently 12 Districts using DrChecks. Pacific Ocean Division has standardized on the use of CLL for capture of Division LL. A national repository for lessons learned related to the Whole Barracks Renewal Program has also been funded by CEMP-EE.

(b) Prepared MNS and SDP
(c) Prepared LCC Economic Analysis with results from Design Quality LL Repository
(d) Map COE Command Data Dictionary entities and identify relationships to the existing CLL data structures. Work in progress by contractor is larger than the original plan as the goal is now to find all indices in Command Data Model appropriate for other LL applications beyond Design Quality.
(e) This work involves the design, implementation and testing of a distributed, robust CLL Registry that can direct users to CLL registries for business processes selected by IS proponents with the assistance of CECI.
(f) The focus if this effort shall be to identify and develop efficient and user appropriate methods to locate and return potentially re-usable lessons to both the IS business process user. Various modalities of fostering lesson re-use shall be explored.
(g) The data exchange format will be an XML-based technique to support the free exchange of information from distributed knowledge repositories,
(h) The effective management of the CLL effort shall require comprehensive reports that track performance, use, and benefits. Considerable efforts shall be required to identify, scope, and program these reports. Examples of these types of reports have been developed for DrChecks and could be extended to other ISs.
(i) New IS' participation in CLL may either be funded as line items in that IS' budget. CLL Module 1 component will provide the 'yes/no' lessons learned submission button to the appropriate location within an existing IS and local review and approval capability. The repository update will support the addition of additional indexing and routing features need to support the additional IS.

2. Recurring Costs for CLL

Specific cost for recurring cost are identified on Table 2. The recurring costs for the first three years of operation are shown above. As additional business processes or lessons learned repositories come on-line the cost is expected to rise slightly. This rise will be primarily in increasing user group communication tasks from one-half man-year to one man-year. The total recurring costs is not expected to exceed $250K

Table 1-2 Recurring Cost for CLL

ACTIVITY (FOR ALL USERS)	ESTIMATED COST
One man-year for telephone hotline support	$100K
One-half man-year for program enhancements	$ 50K
One-half man-year for user group communication	$ 50K
Total	$200K

C. Life Cycle Value of Benefits:

Based upon the evaluation of only one prototype application use of CLL with DrChecks, it is estimated that completion of CLL Registry, which will allow all Corps Districts to utilize the existing lessons, cost avoidance to the Corps is estimated to be $52.8 million within the first 7 years of operation. This represents a multiplier effect of over 18. The expected Savings to Investment Ratio (SIR) of this system is conservatively estimated to be greater than 140. As more and more existing ISs begin to use CLL, the SIR will grow dramatically as only the marginal cost for addition will only be for: the addition of a submit and find button to the IS, structuring a review and approval capability, and a registry update. Similarly, the Discounted Payback Period (DPP) for CLL is only 2 years. The complete Economic Analysis is provided in Appendix A.

D. IS Funding Source and Cost Recovery

1. One-Time Cost

FY00 focused on development of LCMIS documentation and project management. Creation of a System Decision Paper and Economic Analysis were initiated. In addition, the data mapping necessary for further system development was also initiated. A prototype CLL was funded for by earlier R&D monies.

FY01: CLL Phase 1 the major effort it to develop the programs necessary to expand CLL to collect and link lessons from various applications. The CLL Registry (3 in Figure 1) will direct users to CLL repositories for business processes outside the current Design Quality Business Process. Secondary efforts during the first year will also include the revision of existing CLL applications to accommodate the Command Data Dictionary data mapping. An additional minor effort for the first year effort will include the development of a user selected targeted CLL push technology. The goal of this effort is to automatically spawn queries to the CLL to see if lessons exist that relate to the user's current actions and to notify the user of their existence. In addition, this effort will allow the user to "tailor" the type of notification they receive. Hence since this push technology will be tailored to exactly the user need, improved re-use of stored lessons is to be expected over that of the traditional method of having to separately initiate a query.

FY02: The primary focus of this year's development is the Data Exchange Format. This XML-based technique will support the automated communication among distributed CLL repositories. A secondary effort for the second year will be the development of the appropriate CLL process management reports that identify lesson development periods, lesson re-use, and estimated benefits obtained.

FY03 and later years: The CLL cost will be limited to system maintenance (Table 2). The cost associated with incorporation of other ISs into CLL (Table 1) shall be borne by the IS's operational budget. Specific tasks will involve the adding the 'yes/no' lessons learned submission button to the appropriate location within the existing IS and adding the approval and local repository. The CLL Repository updates will support the addition of additional indexing and routing features need to support each additional IS. To both guarantee a short programming period and successful new IS integration, a comprehensive analysis of benefits followed by a marketing program of CLL benefits will be required by the CLL proponent/program manager to the appropriated IS proponents.

2. Recurring Cost

Recurring cost falls within three separate categories: telephone hotline support, program enhancements, and user group communication. Eventually, when the number of applications using CLL grows the entire cost of this effort could be borne by their O&M programs. Initially, centralized support maybe necessary for initial funding of the first two requirements ($100K for hotline support, and $50K program enhancements). It is anticipated that each application using CLL shall be able to fund the user group communications at $50K per year.

V Technical Considerations

A. Joint Technical Architecture

CLL is being created on a web client-server platform. The HTML forms presented to the user are created with HTML and Java Scripts and are dynamically driven by COTS data base product (Cold Fusion). No Java applets or ActiveX controls will be used in CLL. These restrictions as to active content are consistent with web accessibility standards. SQL Server will be utilized as the robust data platform. This choice was made to allow external military and governmental agencies to use this product without violating Corps licensing agreements. Each group shall have its own database but will share page templates.

B. Demonstrated Requirements

The CLL concept (functionality and applicability) has been successfully demonstrated with the DrChecks application. At present 12 Districts are using DrChecks and CLL for their design review business process. Benefits of re-use of knowledge captured by the CLL module in DrChecks have been documented at Seattle District by an economic analysis (See Appendix).

C. Interoperability, Interfaces, and Integration Considerations

The entire design intent of CLL is to ensure interoperability, interfaces, and integration. Interoperability is met by using the legacy IS to capture the LL. All that is required is to add a CLL yes/no button within the existing program for capture and re-use functions. Significant legacy reprogramming will not be required to add this feature hence limited or no interoperability issues are expected. Since CLL will utilize local gate keeping for lesson review and content approval, interface and integration issues are not expected. The Registry concept will support TCP/IP interoperability between data repositories by providing cross-references between data sources. The XML Data Exchange Format will eliminate the interface and integration issues between differing repositories, which may store information using different data descriptors.

D. Electronic Record Keeping Plan

Hourly, daily, and weekly backups of all CLL data to shall be made to local disk. Weekly backups of data and web pages shall be stored to removable media and stored. Media will be rotated every four weeks.

E. Configuration Management Plan

An evolutionary development strategy is being followed. The objectives of the build strategies will be identified and periodically reviewed and updated following joint reviews and an evaluation of user submitted system change proposal (SCP). This review shall be accomplished through the use of DrChecks. A numeric scheme shall be followed to record major and minor changes to the operational system. A technical support application on DrChecks will be used to capture all technical support calls and SCPs.

F. Data Management Plan

Active CLL issues shall be maintained within the system until they have been identified for removal (sunsetting). Three methods of removal shall be available: (a) user identification of a topic no longer applicable which are reviewed and approved by a gate keeper, (2) subject matter expert review and decision to remove, and (3) regulation/requirement change that no longer makes the lesson appropriate.

The LL Registry and Repository, which supports the sharing of CLL across different business practices, shall utilize the Command Data Dictionary (CDD) as a mean of insuring the CLL captured and retrieved across various ISs do, in fact, relate to the same data elements. Categories of information within the CDD that relate to each existing CLL database shall be identified. The managers of this data shall be identified for reference by the CLL. Regulations or other documents that identify the allowed values for index-type data structures will be identified and documented. Currently allowable values for all index-type data structures will be identified and documented based on these standard sources

G. Testing and Evaluation Master Plan

Prototype testing of this CLL project was accomplished with the deployment of DrChecks at Seattle, Huntington, and Baltimore Districts in FY98. These three test sites actually subscribed for the use of the Design Review and Checking System. Both of the functionality and benefits of the prototype CLL were clearly identified during this test. While the prototype testing only evaluated the local creation, local approval, and local re-use of lessons, it was clear that CLL could effect a significant improvement in the design quality business process. An extremely conservative economic analysis supported these observations. Since the intent of CLL is to deploy it to a variety of business processes and only a small marginal additional cost per additional application will be required, a significant increase in the benefits of CLL is to be expected.

CLL will be implemented in two separate phases. During the first year (Phase 1), the implementation of the Registry with the existing DrChecks applications will be accomplished. Prior to testing of the Registry, Districts POCs will be notified about the effects of the registry linking of existing local data bases, the ability to recover lessons from other districts, and the features of the user selectable push technologies. After notification, districts will use the first application of CLL (DrChecks) and the CLL Repository to capture, evaluate and search lessons learned. At the conclusion of a four-month test period, districts will prepare a report describing their use of the system. CERL will prepare a summary of the test, including all system design and administrative documents, and forward the complete package to HQUSACE. The submission of this final package of materials in Draft Report format will complete the testing and evaluation portion of Phase 1.

Phase 2 shall involve the addition of the data exchange format to the registry that will allow retrieval of lessons from a different IS. While proponents for ISs in conjunction with CECI will identify the appropriate IS, one possible candidate closely associated with the Design Quality Business Process is the COE Resident Management System (RMS). The addition of the RMS IS will allow the capture of lessons related to the actual construction and delivery of facilities to the end user. Clearly lessons captured here will be very beneficial upstream during the design delivery process.

It is anticipated that a one to two quarter test period will be required to adequately test the functionality of the data exchange format in adequately linking the lessons between the differing business processes of design and candidate selected. At the conclusion of the test period, CERL would prepare a summary of the test, including all design and administrative documents, and forward the complete package to HQUSACE. The submission of this final package of materials in Draft Report format would complete the testing and evaluation portion of Phase 2.

H. Internal Controls and Security.

Department of State is conducting a formal security accreditation testing of current version of CLL with a design quality application. This accreditation process includes simulated attacks on the site. All security experience gained from this process shall be applied to the CLL Phase 1 and 2 development efforts.

1. External network access restrictions.

   Before accessing CLL, all users must get access to the CLL web site through an Internet service provider. All providers, including Corps' networks, require that users have valid login names and passwords.

2. User Identification.

   All users must register to use the CLL. This registration places security ID in the cadre of each browser. This security ID is used by the CLL to identify individual users by the computer on which the registration occurred. Providing access to an individual's computer is the responsibility of the person who "owns" each personal computer registered with CLL.

3. Access Rights.

   Individual CLL system administrators assign access to view/add/update/delete data. The administrators will restrict access to those who should have such access as part of their task in each CLL business practice.

4. Data Creation/Update Tracking.

   Add and update query activity is recorded without the users' knowledge for all such transactions.

I. Post Deployment Software Support (PDSS) Plan

Each existing IS utilizing CLL shall pay and manage the development of a one-time cost not to exceed $200K for CLL 1, 2, and 3 (yes/no button, local review, and Registry update) that will support a LL search function. If the IS is significantly upgraded, a CLL interface update may also be required and should be included in the IS upgrade budget.

A single IS funded annual user support fee not expected to exceed $50K/yr will provide support for LL exchange and assistance in searching remote data repositories.

J. IS Technical Documentation

All CLL development coding utilizes self-documenting capabilities of an "object oriented" approach using fuse box. This is self- documenting coding is augmented by on-line help manuals and materials that provide a complete on-line approach to system documentation.

The evolutional design has been published in technical reports that cover the past MIL Std 498 requirements.

VI Signature and Approvals

A. IS Functional Proponent (FP)

Original signed by
Mr. Wilbert Berrios
CIO

B. Milestone Decision Authority (MDA)

Original signed by
Mr. Wilbert Berrios
CIO

VII Appendix: CLL Economic Analysis

Economic Analysis of the Corporate Lessons Learned (CLL) System

Submitted to

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July 5, 2001

FINAL REPORT

EXECUTIVE SUMMARY

Corporate lessons are created inside an organization when motivated employees do the organization's business in new and innovative ways that save resources and/or improve quality and efficiency. Research efforts at the US Army Construction Engineering Research Laboratory have developed a Corporate Lessons Learned (CLL) Automated Information System (AIS) for capturing, storing, and sharing corporate lessons before they are lost. The first phase of this system has been fielded, and there is enough experience to begin estimating the benefits derived from its usage.

An Economic Analysis (EA) of CLL was performed in support of the US Army Corps of Engineers' (USACE) Life Cycle Management of Information Systems (LCMIS). Future costs and savings were estimated to determine the Savings to Investment Ratio (SIR) and the Discounted Payback Period (DPP). Lessons already in use at one Corps district office were analyzed to project future savings. The analysis shows a SIR of 120 and a DPP of 2 years. Moreover, CLL Phase 2 can save USACE $53 Million during the first five years of operation.

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1. INTRODUCTION

Background

At the heart of the Corps of Engineers mission is the delivery of facilities and infrastructure to Army and Air Force installations and to the Nation's waterways. Accomplishing this mission includes planning, design, construction, operation, and restoration of a wide array of engineering projects. These activities, in turn, entail the support of other functional areas such as procurement, finance, and human resources. Experience gained from past projects has to be incorporated into new designs, construction methods, maintenance procedures, procurement methods, and financial strategies. Most importantly, the experience gained needs to be transferred accurately to new employees. Moreover, the fact that these facilities are for large, complex organizations adds complexity to the management and coordination of experience transfer.

It is the knowledge and experience employees gain from doing the organization's tasks and business that provide a competitive advantage to an organization. The customer-specific knowledge and experience that are generated internally, by talented and motivated employees in the act of achieving the organization's mission in new and innovative ways, have to be shared and stored for future reference. This knowledge is the so-called "how-to" knowledge. Examples might include how to reduce the duration of a construction project or how to reduce the cost of a facility. It is this "how-to" knowledge that is uniquely developed by a specific organization and is often referred as Corporate Knowledge.

This knowledge is generated by teams of people and resides within them. When the team disbands, the knowledge also disbands. If another team in the organization needs that knowledge, their members will have to reinvent it. This effort is redundant and unnecessary. In addition, when employees leave the organization their corporate knowledge and experience leave with them. To prevent this loss, corporate knowledge has to be captured and stored. Capturing knowledge is time consuming, and it is not the first instinct of team members. Moreover, for the corporate knowledge to benefit other teams in the corporation, it has to be shared. Sharing information and knowledge runs counter to the instincts of most managers because it takes time but does not reward the donor.

Management has long recognized the need to keep and share this knowledge before it is lost. Design Guides, Engineering Letters, Army Regulations, and Prospect Courses, are all different systems for keeping and sharing corporate knowledge. Automated systems have also played a major role in keeping and distributing corporate knowledge and are poised to play an even greater role in this area. Early automated systems for storing and sharing corporate lessons learned included Bulletin Boards, News Groups, Computer Forums, and E-MAIL. Although these systems serve well the group and/or business process they support, there is still a considerable amount of knowledge that doesn't get shared across different groups and business processes of the organization.

Current innovations to overcome this shortcoming consider corporate knowledge as a strategic asset and knowledge management as an integral part of the corporation's strategy[*]. Organizations like the World Bank and Ford Motor Company report large savings from deploying integrated knowledge management systems[†]. In order to capture those savings at the Corps of Engineers, Information Technology (IT) managers are developing an integrated Knowledge Management (KM) system for capturing and sharing knowledge across different groups and business processes of the organization[‡].

[*] What's Your Strategy for Managing Knowledge? By Morten T. Hansen, Nitin Nohria, and Thomas Tierney; Harvard Business Review, March-April 1999.
[†] Common Knowledge: How Companies Thrive by Sharing What They Know; By Nancy M. Dixon; Harvard Business School Press; Boston, Massachusetts; 2000.
[‡] Abbreviated System Decision Paper (ASDP) Corporate Lessons Learned (CLL), By Bill East, Construction Engineering Research Laboratory, May 1998.

Objective

The benefits of keeping and sharing corporate lessons learned must be larger than the cost of developing and implementing such a system. Current Army Corps of Engineers regulations require that procurement and development of new Automated Information Systems (AIS) follow a disciplined management approach called Life Cycle Management of Information Systems (LCMIS)*. This approach calls for performing and documenting an Economic Analysis (EA) of alternative systems under consideration to insure that the best-value alternative is selected before proceeding with system development.

The objective of this study is to perform a formal Economic Analysis (EA) of the different alternatives available to capture, store, and distribute the corporate knowledge gained in delivering quality facilities and infrastructure to the Army, Air Force and the Nation. In addition, this EA is a key part of the LCMIS documentation of the merits of alternative solutions and will assist in the final system selection and funding.

An economic analysis provides a systematic method for studying problems of choice. Various ways to satisfy a requirement are studied by comparing the cost and benefits of each alternative course of action. The analysis states clearly the requirements of the system to be procured and the alternative ways to fulfill them. The analysis also documents the economic assumptions made to resolve uncertainty as well as the estimating techniques used for costing future benefits. Finally, the analysis identifies and recommends the best-value alternative to fulfill the requirements.

Approach

This analysis follows the seven-step process outlined in the Automated Information Systems (AIS) Economic Analysis Handbook of the Army Corps of Engineers.† These seven steps can be grouped into four major activities, namely, Study Formulation, Determine Costs and Benefits, Perform Analysis, and Report Results. This process, when closely followed, assures that the best-value alternative is recommended.

Study Formulation

This activity groups together the first three steps of the Economic Analysis process. These three steps involve formulating and structuring the study as a decision problem. The first step defines the objective of the decision. The second step involves formulating assumptions and identifying constraints beyond the analyst/manager control so that different alternatives can be compared fairly. The third step of the EA process involves the identification and description of all relevant alternatives that could solve the problem.

Determine Costs and Benefits

This activity encompasses the fourth step of the Economic Analysis (EA) process, which is the determination and estimation of the different costs and benefits of each feasible alternative. The key to this process is the identification of the different cost elements involved and the gathering of accurate and relevant values to represent them.

Perform Analysis

This activity groups the next two steps of the EA, steps five and six. Step five involves the evaluation of the different alternatives according to the costs and benefits obtained before. Step six involves performing a sensitivity analysis to determine if the alternative chosen in step five is the most cost effective after changing some of the assumptions made in steps three and four.

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* ER 25-1-2; Life Cycle Management of Information Systems (LCMIS); U. S. Army Corps of Engineers; 31-August 1999.

† Automated Information Systems (AIS) Economic Analysis Handbook; U.S. Army Corps Of Engineers; December 1992.

Report Results

The final step of the EA process is the reporting of the results. This step involves documenting all estimates and explaining recommendations.

Scope

This study is an economic analysis. It is not a budget analysis. Economic analysis and budget analysis are different processes. Economic analysis is used for determining the most cost-effective alternative that meets the organization's requirement. Budget analysis provides an organization with the total cost impact of an alternative. Data presented in an economic analysis may or may not be useful in a future budget process. Some costs are omitted from the economic analysis because they are wash costs[*]. Also, some costs included in the economic analysis may refer to several organizations, making it difficult to use in the budgeting process.

Mode of Technology Transfer

This EA will serve as a detailed background document information of LCMIS documentation. Summary information from this document will be used in the LCMIS System Decision Paper.

[*] Wash Cost: A cost that is identical for all alternatives.

2. KNOWLEDGE MANAGEMENT OVERVIEW AND SYSTEM REQUIREMENTS

Introduction

When faced with choices between multiple solutions, often the hardest part of making a decision is developing a good understanding of the problem. This certainly is the case for selecting an information system. A good understanding of the system's requirements is approximately one half of the effort required to identify a solution to the problem. That is why the most important part of an EA, and also the first part, is properly formulating the problem. In this case, doing so requires some understanding of Knowledge Management (KM) concepts.

Knowledge Generation

Corporate knowledge is created inside an organization when motivated employees do the organization's business in a new and innovative way that saves resources and/or improves quality and efficiency. Since most of the tasks and objectives of an organization are performed by teams, employees generate corporate knowledge. Before this corporate knowledge can serve a different team in the organization, it has to be converted into a lesson. A lesson is a set of rules or principles that summarizes pass experiences in such a way that helps the originating team perform its future tasks better. To make a lesson out of an experience takes reflection and willingness. When a team in a different part of the organization uses this lesson, cost savings accrue rapidly.

Knowledge Transfer

Unfortunately, knowledge transfer does not happen spontaneously. One reason is that the generating team lacks business incentive to transfer it to other groups. Another reason is that the receiving team does not know of its existence. For knowledge transfer to be feasible and efficient, four things must happen. First, there have to be media to carry the knowledge. Second, the knowledge has to be translated into a format that others teams can use. Third, the receiving team has to adapt the knowledge to its own context. And fourth, the receiving team has to perform the new task using the knowledge transferred. Thus, the choice of information management infrastructure will affect the efficiency and effectiveness of a Knowledge Management System (KMS).

USACE KMS Requirements

A knowledge management system able to capture and transfer lessons learned across the different business processes of the organization has to capture knowledge where it is generated. For a lesson to become a corporate lesson it has to be evaluated by a team and translated into the proper media to be distributed. Moreover, the corporate lesson has to be easily available for the user when he or she needs it. Finally, the lesson learned has to be accessible to other groups in the same business process as well as in other business processes. Figure 2-1 shows the different working groups within the engineering process in the U. S. Army Corps of Engineers (USACE). Workload flows from left to right. The procurement, financial, and other support processes run parallel to the engineering process.

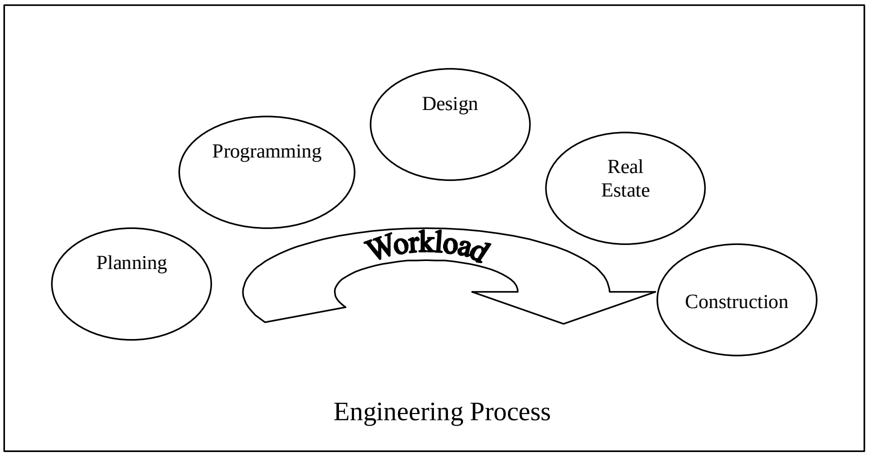

Figure 2-1: Engineering Business Process Groups

Not all lessons-learned sharing methods are the same. Different groups have different communications needs and infrastructures. A knowledge management system able to share information across different organizational groups needs to support four different transfers of lessons learned. Figure 2-2 shows three of the four different types of lessons-learned sharing among groups commonly occurring at USACE. The arrows in the figure indicate the direction of the lesson transfer. The arrows start in the originating team and end in the receiving team.

The Four Types of Lessons Sharing

The first type of lesson shared takes place within the same group that generates it. This is the case of the design group in the Seattle District sharing a corporate lesson with all its members. This type of sharing occurs frequently.
The second type of lesson shared takes place between different groups but within the same business process. This will be the case of the design group in Seattle sharing a corporate lesson learned with the construction group, with both groups working as part of the engineering business process in the same district. This type of sharing is also frequent, and usually both teams benefit from the lesson.

The third type of lesson shared takes place when a lesson learned by a group is shared with another group from a different business process. This will be the case of the design group in the engineering process of the Seattle district sharing a lesson with the contracts group of the procurement process in the same district.

The fourth type of lesson shared takes place when a strategic task has to be accomplished by an office using knowledge and expertise from several parts of the organization. This would be the case of a district restructuring and sharing the lessons learned with another district that has to restructure six months latter. The kind of tasks supported by this transfer of knowledge occurs infrequently but is critical to the whole organization.

Type 3

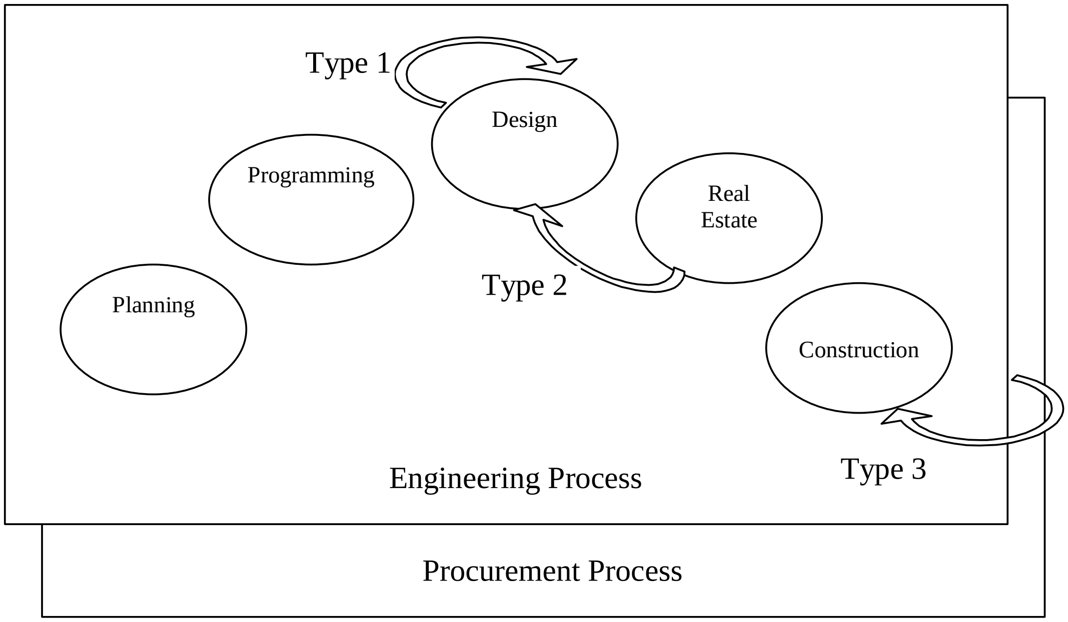

Figure 2-2: Three Types of Lessons Sharing

Necessary System Requirements

The knowledge management needs at USACE, as described above, can be summarized in seven system requirements as follows:

- Capture lessons learned
- Evaluate lessons learned
- Store lessons learned
- Share lessons learned within group
- Share lessons learned with other groups within business process
- Share lessons learned with other business processes within the same district
- Share lessons learned with others groups and processes Corps-wide

These are the system requirements against which the different alternative systems will be evaluated.

3. STUDY FORMULATION

Definition of Objectives

This is the first and the most important step of the EA because the adequacy or inadequacy of an alternative is measured against the objective of the project. An improperly stated objective will result in an improper solution. In other words, the analysis will provide the right solution to the wrong problem.

USACE Knowledge Management Problem

Sharing lessons learned is a management objective of all Corps business areas. Although there has been significant management effort to support lessons learned, the tools needed for capturing, reviewing and transferring them have not been currently available. Attempts to centralize lessons learned to date have been unsuccessful due to the fact that users are unable or unwilling to access central knowledge stores. Previous attempts to develop distributed systems resulted in systems that lacked long term sustainability. Finally, stand-alone databases are also difficult to find by those outside a specific region or subject matter domain.

Project Objective

The objective of this project is to provide the USACE with a KMS architecture able to support different knowledge transfers necessary to implement successfully a lessons-learned feedback system. The KMS must support the four types of lessons-learned sharing described in Chapter 2.

Formulation of Assumptions

In order to perform an EA of several alternatives, some assumptions about future events need to be made. Following is the list of assumptions used in this analysis:

- The start year of the study is FY1999.
- The lead time (period extending from the start year to the completion of installation) is 2 years.
- The economic life of the selected alternative is 7 years.
- Engineering activity at the districts is expected to remain at the same levels as in previous years.
- The real discount rate is 4%.

Identification of Constraints

Constraints are anything beyond the project manager control and or beyond the control of the analyst that may affect the evolution of the KMS or the result of the analysis

- It is not possible to determine with certainty the number of new sites that will use the proposed KMS in the future. To make a conservative estimate of the Savings to Investment Ratio (SIR), this analysis assumes that only the 11 sites that currently have the software will be the future users.
- Although Corps' customers also benefit from some of the lessons learned, this analysis takes a conservative approach and considers benefits only to USACE.
- It is difficult to predict the future growth in the number of lessons learned generated by the users. This analysis, therefore, conservatively assumes no growth in the number of new lessons learned after the first year of usage.
- Funding for incorporation of CLL into each additional AISs will require approvals, and the programming of funding. Since the timing of these actions cannot be estimated, all benefits were assumed against the initial CLL application only – DrChecks. The benefits identified in this analysis can be extrapolated to other AISs.

Identification of Alternatives

The third step of the EA process involves the identification of reasonable ways to meet the requirements of a KMS for the Corps. In this stage it is important to make sure that all of the relevant and reasonable alternatives able to meet the requirements described earlier are considered in the analysis. The alternatives contemplated in this analysis were selected by a group of analysts and knowledge management practitioners after examining readily available solutions and popular practices among a wide array of organizations. The existing architectures for generating and transferring corporate lessons are the following:

Status Quo

This alternative is the "As Is" system at the Corps of Engineers. Currently, some offices have standalone lessons learned databases associated with specific topics or specific technical subjects. These systems are primarily operated through local champions and have not been fully integrated into the business process that produces the knowledge. Also, these systems are not uniform within an existing district or throughout the different districts. As a result, employees from a different district or business process rarely have the opportunity to utilize the knowledge created outside their group.

Verbal Based System

This system is not an automated system, but it is prevalent in many organizations as a way to transfer corporate lessons. It emphasizes word-of-mouth, meetings, and professional conferences as preferred vehicles for knowledge transfers. In this system, the receiving team seeks the necessary knowledge by asking likely sources of similar past experiences for information. This knowledge search is based upon asking peers and acquaintances for referrals and clues relevant to the problem at hand. This system is popular in academic institutions. Also, this architecture does not support knowledge generation.

Training

This architecture focuses on transferring general corporate information. An example of this system is the "New Employee Orientation Course" found in many large organizations. This architecture places special emphasis on documenting knowledge. It is good for transferring knowledge used in frequent and repetitive tasks common to most people in the organization.

Business Process Specific Centralized Knowledge Repository

Under this architecture, lessons are stored in a central database that pertains to a specific topic. The focus of this system is in supporting the team or teams involved in the specific process. An example of this kind of system is the Corps of Engineers Construction Evaluation Retrieval System (CERS).

Dynamic Integrated Corporate Lessons Learned (CLL) System

This is the proposed KM system. This architecture is made up of three components, namely, the CLL Module, the CLL Repository, and the CLL Registry. The CLL Module supports the capturing of the lesson and resides within a process-specific Automated Information System (AIS). The CLL repository receives the lessons generated by the CLL module and supports their evaluation by experts. This repository can accommodate lessons generated by different AIS. Finally, the CLL Registry supports the transfer of knowledge to other teams by making the different repositories available to different groups.

Strengths and Weakness of each Alternative

Each of the alternatives listed above has some strengths and weaknesses. The following is a discussion of the strengths and weaknesses of each alternative for supporting the requirements identified in Chapter 2.

Status Quo

Strengths:

- Is able to capture lessons specific to a local team although not as part of the workflow.
- Supports knowledge transfer of Type 1, also known as serial transfers.

- Is able to share lessons with other groups within the same business process, but not in a timely fashion when the groups are not collocated.

Weaknesses:

- Does not capture lessons learned as part of the workflow because the system is usually a stand-alone system.
- Does not support the evaluation process.
- Makes the transfer of lessons to other business processes difficult due to the lack of a lessons-learned clearinghouse registry.
- Makes Corps-wide transfer of lessons difficult.

Verbal Based System

Strengths:

- Through meetings teams can capture and evaluate lessons relevant to their members when all of them are collocated.
- Through word-of–mouth, new team members can learn corporate lessons from more experienced members.

Weaknesses:

- Since lessons reside with people, knowledge leaves the organization when people leave.
- The scheduling of meetings and conferences complicates the transfer of lessons outside the originating time.
- Some potential users of lessons cannot attend all meetings.

Training

Strengths:

- Lessons stored with this system tend to be well documented.
- The person or group responsible for putting the course together makes a careful evaluation of the lesson.

Weaknesses:

- Does not capture lessons as part of the workflow. Only the lessons captured before the training course are presented.
- The difficulty to schedule training complicates the sharing of corporate knowledge with other groups. The relevant course may not be offered when it is needed.
- Not all the lessons in a course are relevant to all the attendees, and not all potential users attend the course.
- Is not efficient for transferring local lessons.

Business Process Specific Centralized Knowledge Repository

Strengths:

- This system is able to store many lessons and their corresponding documentation.
- This system supports knowledge transfers within a group.

Weaknesses:

- This system does not capture lessons as part of the workflow. The lessons must be captured by experts and evaluated before they go into the database.
- The lessons are not easily and readily available to other groups outside the originating team because these systems often are stand-alone systems that have limited access and that only have a few indexes relevant to the originating business process.

Dynamic Integrated CLL System

Strengths:

- Captures lessons as part of the regular workflow of the user.
- Supports the evaluation process of lesson by making communications among the evaluating team easy.

- The same system stores lessons and indexes, making it easily accessible to other business processes and other groups Corps-wide.

Weaknesses:

- This is not a stand-alone system, and it requires an AIS to capture lessons. Currently this system is working with Design Review and Checks (DrChecks) and can easily work with other AISs, but it will not work without an existing AIS to support the collection of lessons to be incorporated.

Comparing Alternatives Against Requirements

A careful review of the above strengths and weaknesses analysis reveals that some of the alternatives considered do not fulfill the requirements of a KMS for USACE. Table 3-1 summarizes the strengths and shortcomings of each alternative. The column named Requirements lists the seven desirable functions of the KMS as identified in Chapter 2 of this report. Each one of the five alternatives considered by this analysis is represented in the column with its name at the top. Each requirement is represented by the row with its name in the left-most column.

This table shows that only the Status Quo column and the Dynamic Integrated CLL System column support all the desirable requirements described in Chapter 2. As a consequence, only these two alternatives will be evaluated further.

Table 3-1: Decision Table Comparing the Alternatives against System Requirements

	Alternatives				
Requirements	**Status Quo**	**Verbal Based System**	**Training**	**Business-Process-Specific Centralized Knowledge Repository**	**Dynamic Integrated CLL System**
Capture LL	Marginally Does not capture lessons learned as part of workflow	Yes	Marginally Only lessons worth putting into a course are captured	No Does not capture lessons learned as part of workflow	Yes
Evaluate LL	Marginally Does not support the evaluation process as part of workflow.	Yes	No Lessons are evaluated by instructors and not by users.	No Does not support the evaluation process as part of workflow	Yes
Store LL	Marginally Lessons are spread through different systems and media	No Knowledge leaves the organization when people leaves	Partially Only popular lessons become part of a course	Yes	Yes
Share LL within Group	Yes	Marginally	Partially	Yes	Yes
Share LL with other Groups within Business Process	Partially	Marginally	Partially	Partially	Yes
Share with other Business Processes within the same District	Partially	Marginally	Partially	Partially	Yes
Share with others Groups and Processes Corps-Wide	Limited	Partially	Partially	No	Yes

4. COSTS AND BENEFITS

Introduction

Determining the costs and benefits associated with the feasible alternatives is the fourth step of an EA. This part of the analysis focuses upon two alternatives namely the Status Quo and the Dynamic Integrated CLL System. Since there are only two alternatives and one of them is the Status Quo, this alternative will be the baseline of the EA. As a consequence, the cost and benefits of the status quo are considered to be zero ($ 0.00), and all the estimates for the CLL system are extra costs and benefits over the costs and benefits of the status quo. Doing so simplifies the analysis to the point of making it possible, but renders the figures used here unusable for budgetary proposes. However, the figures and findings are useful for decision making.

The CLL system has been developed in two phases. The first phase was the development of the CLL module and the CLL repository. This first phase was completed in Fiscal Year 1999 (FY99) and the system was fielded in the Seattle District and at other sites in FY00. This part of the system has now been working for one year at the Seattle District as part of DrChecks in the design review business process. After one year of testing and use, there is enough experience to estimate the benefit of using it in this particular business process. Future plans call for the addition of the CLL module to other AIS's to support other business processes. As a consequence, the only accurate estimates of benefits possible at this time are those associated with the design review business process.

The second phase of the CLL project is the development of the CLL registry. This part is currently under development. This registry will allow the sharing of lessons among different business processes and thus, further compound the benefits of the lessons learned.

Source and Derivation of Costs

The cost of the status quo is the baseline cost and hence it is set to $ 0. All the cost elements can be categorized as Investment (Nonrecurring) Costs or as Operations (Recurring) Cost.

Investment (Nonrecurring) Cost

- The development cost of the first phase of CLL was $55,000. The Corps of Engineers Research & Development (R&D) program funded this development cost as an add-on to DrChecks. There are currently 11 sites using DrChecks/CLL. Therefore, the development cost per site was $55,000 / 11 = $5,000.

- This software resides on an internet server. The only requirement to use it is to be connected to the Internet and to use a free browser (Microsoft Internet Explorer™). All the Corps districts are currently connected to the Internet. Hence, there is no extra hardware or software cost to the districts.

- Although CLL is separate software that collects information from others AIS, it is intended to work seamlessly with the corresponding AIS. In this evaluation CLL collects information from DrChecks and the local system administrator has access to a support center through a phone line. This service is part of the annual subscription for each site. Most system administrators use this phone service to ask the necessary questions to get started with the software. It is estimated that the average site uses 40 hours per year of this service. Hence, the cost of training the local system administrator is assumed to be 40 person-hours at an average of $75 per person-hours [*]= $3,000. However, that training is for DrChecks and CLL. The part for CLL is estimated to be 25% of the $3,000 or $750.

[*] This is the hourly labor rate used internally by the Seattle District to estimate their costs of doing business.

Operations (Recurring) Cost

- In addition to using the phone service, new users of CLL tend to ask questions to local system administrators regarding the program. To estimate the cost of the local system administrator, this analysis focuses on the district with the longest experience using CLL, the Seattle District. The system administrator in that district dedicates 40% of her time to DrChecks/CLL. She estimates that 20% of that time is used supporting CLL users. Assuming that the administrator records 1,800 hours per year of direct labor, the yearly cost of administrator to CLL is = $75/Hour * 1,800 Hours/Year * 40% * 20% = $10,800 per year.

- At the receiving end of the support imparted by the system administrator are the CLL users. The amount of time expended by the users to confer with the system administrator is equal to the amount of time the system administrator dedicates to it. Hence, the recurring training cost of CLL is another $10,800.

- The other recurring cost to the district is the annual subscription cost of $12,500. That cost includes 40 hours of extended service request. Since the software resides in a server in the Internet, all the updating costs and maintenance costs are included in the service cost. Again, this cost is for DrChecks and CLL. The CLL part is assumed to be 25% of it, similar to training. Hence the annual software maintenance cost is 25% of $12,500 = $3,125.

- Finally, each lesson has to be evaluated before it becomes a lesson learned. The users at the Seattle district estimate that, on the average, it takes one person-hour to evaluate each lesson. In 2000, there were 52 lessons evaluated in the district. Assuming a labor cost of $75 per hour, the cost to evaluate the lessons at Seattle in 2000 was

($75/Hour)*(1 Hour/Lesson) * 52 Lessons = $3,900.

Table 4-1 shows the above costs for the first site where CLL Phase 1 was operational, the Seattle district. The larger the number of sites using CLL successfully, the smaller the share of the initial investment cost to each site.

Table 4-1: Cost of CLL Phase 1 for the first site

Cost Element	CLL Phase 1
Investment (Nonrecurring) Costs	**$5,750**
Initial Software Development	$5,000
Hardware	$0
Software	$0
Local System Administrator Training	$750
Operations (Recurring) Cost	**$28,625**
Annual Local System Administrator	$10,800
Annual Training with System Administrator	$10,800
Annual Cost of Evaluating Lessons	$3,900
Annual Fee for Each Site	$3,125

Table 4-2 shows the costs associated with developing and fielding CLL Phase 2. These figures were taken from the Mission Needs Statement (MNS) of CLL[*]. This table, unlike the one above, shows the costs Corps-wide. This facilitates the comparison of these costs with future benefits. There are currently ten USACE Districts plus the Whole Barracks Renewal Program using DrChecks/CLL. Corps-wide, the future system administrator cost is estimated to be 11 times the cost estimated for the Seattle district above, or 11 * $10,800 = $118,800

[*] Corporate Lessons Learned (CLL) System, Mission Needs Statement, By Bill East, Construction Engineering Research Laboratory, October 2000.

Table 4-2: Projected Cost of CLL Phase 2 for all sites

Cost Element	FY01	FY02	FY03-07
Investment (Nonrecurring) Costs	**$200,000**	**$200,000**	
Initial Software Development	$165,000	$175,000	
Hardware	$20,000	$20,000	
Software	$10,000	$5,000	
Training	$5,000		
Operations (Recurring) Cost			**$437,600**
Annual Local System Administrator			$118,800
Annual Training			$118,800
Annual Fee for all the Sites Together			$200,000

Benefits Elements

There are several different benefits to using lessons learned. Figure 4-1 is a cause-effect diagram of the benefits derived from using lessons learned. At the top of the diagram is the Lesson, and at the bottom are the specific benefits produced by using the lesson.

Lessons are worth keeping and learning for three reasons. First, lessons help to avoid future contingencies by learning from past ones. Or in other words, people learn from their mistakes. By keeping and sharing lessons, people can also learn from somebody else's mistakes. Furthermore, contingencies can result in monetary claims and/or in unnecessary delays. As a consequence, the benefits derived from using these lessons are either to Avoid Claims (AC), and/or to Avoid Delays (AD).

Second, experiences gained during design and construction of facilities can be used to improve future designs. Those improvements can either increase the quality of the facility, or improve the safety of its operations, or both. As a consequence, the benefits derived from using these lessons are to Increase Quality (IQ) and/or to Increase Safety (IS).

Third, after doing the same job several times, we learn to do it more efficiently. Those efficiency gains can result in a lower cost of the engineering process, shorter duration of the process, or both. As a consequence, the benefits derived from using these lessons are Lower Cost (LC) and/or Shorter Duration (SD).

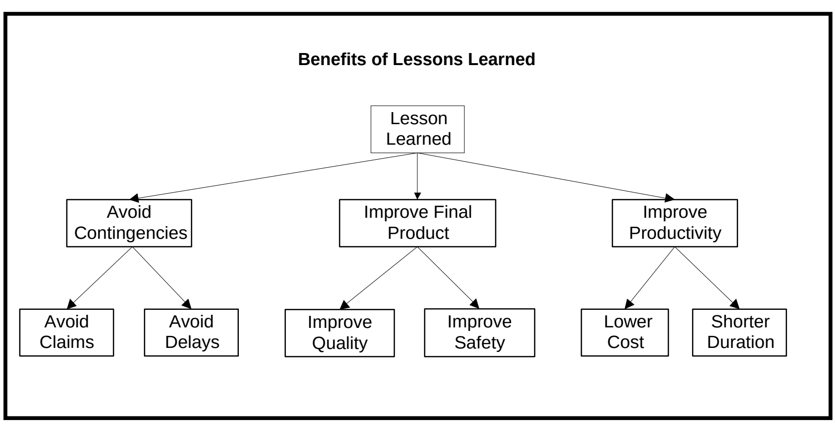

Figure 4-1: Benefits of Lessons Learned

Intangible Benefits Vs Cost Savings.

The six benefits identified above are of different natures. Benefits such as "Improved Quality" and "Improved Safety" are qualitative in nature and it is very difficult to assign a monetary value to them. However for benefits such as "Avoid Claims" which avoids future costs, a monetary value equal to the cost avoided can be assigned to this benefit.

Intangible benefits may be as desirable as tangible benefits. And although it is difficult to assign a dollar value to them, they should be accounted for. Moreover, benefits like improved safety are highly desirable and should influence the choice of system. It is often the case that the tangible benefits may not represent the bulk of the benefits.

Source and Derivation of Benefits

This study analyzes the cost savings associated with CLL by estimating the cost savings associated with existing lessons learned already in use in the districts. Not all the districts have the same experience using CLL. Some districts have been faster than others to implement and use CLL successfully. To estimate the full savings potential of CLL, the analysis focuses on the district with the largest number of lessons approved - the Seattle District. Since this district has also been using CLL longer than other districts, it is reasonable to use its experience in forecasting the savings in other districts.

CLL Phase 1 Potential Savings

Each lesson was analyzed by interviewing the creator of the lesson. Many of the lessons were motivated by contingencies and the desire to avoid them in the future. In those cases, the cost of the contingency was estimated from personal memory by subject-matter experts and past records. In addition, the creator of the lesson was asked to estimate the potential for that contingency to reoccur if the lessons were not shared. This information was used to estimate the annual savings from the lessons.

For example, Lesson Number 32 reads as follows in the Seattle District database (Appendix A):

LsnTitle Drawing Scale Errors

LsnProblem The drawing scale needs to be verified on each design sheet. Simple scaling er-
rors
can result in large modifications, when scaling is all that can be relied upon for dimensioning. Problems can be compounded when drawings are reduced on a
non
uniform basis.

LsnSolution ALWAYS require bar scales on drawings in any illustration, map, figure, photo, etc
as
there is only nominal control over ultimate reproduction scale of the graphic in-
volved.

LsnCreatedBy Mr Dean Schmidt

Interviewing the creator of this lesson reveals that this problem has been happening two times per year for the last several years for the three Air Force Bases (AFBs) that he supervises. As a consequence of the scaling error, modifications had to be written on site for utility lines. This modification cost 6 person-hours at $75 per person-hour. In addition, the modification involved $10,000 of materials and labor. It is estimated by the creator of the lesson that the materials and labor purchased through contract modifications are, on average, 35% more expensive than when they are bought through competitive bidding. As a consequence, the cost of this incident was (6*$75) + (0.35*$10,000) = $3,950. Since this incident has happened twice per year, the estimated yearly savings of avoiding this incident in the future for the three AFBs is
2*$3,950 = $7,900

Finally, analysis of the approved lessons in the Seattle District showed that CLL is further introduced in some areas of the district than in others. This became apparent because most of the lessons come from three Air Forces Bases namely, Fairchild AFB, Malmstrom AFB, and Mt. Home AFB. The part of the Seattle District represented by these three installations is taking the lead in fielding and using CLL. It is expected that the rest of the district will follow the example of the leader and use CLL with the same intensity. Potential lessons currently under evaluation show that this expectation will most likely be fulfilled.

The estimated savings district-wide is obtained by escalating proportionally to the construction program in those lessons where the original estimate only contemplated those three Air Force bases. The construction program of these three installations represents only 45% of the total construction program in the district. The escalating factor is then 100/45 = 2.2. Some lessons, however, pertain to a specific installation and hence are unlikely to

Above is the case of Lesson Number 32. If Lesson 32 were to be used by the rest of the district, it is estimated that the annual savings district-wide would be 2.2 times the savings of using it only in three AFBs. In other words, the annual savings would be 2.2*$7,900 = $17,380. To make sure that lessons are used, the Seattle District requires every reviewer to read the existing lesson learned.

Table 4-3 shows the estimated savings for each approved lesson in the Seattle District database. The first two columns, Number and Lesson Name, identify the lesson in the database. The third column, Type of Benefit, describes the type of benefit derived from using this lesson. Some lessons have more than one benefit. The fourth column shows the estimated cost of the contingency that triggered the lesson. The fifth and sixth columns show the projections of the savings on an annual basis and district-wide, respectively.

A description of each estimate in Table 4-3 is shown in Appendix B: Estimation of Benefits of Approved Lessons Learned in the Seattle District. Also, Appendix A contains a listing of all the lessons in the database of the Seattle District.

Table 4-3: Estimated Benefits of the Approved Lessons Learned in the Seattle District

No.	Lesson Name	Type of Benefit	Contingency Cost	Annual Savings	Expected Savings District Wide
31	CPVC Piping	AC, AD	$30,000	$30,000	$66,000
32	Drawing Scale Errors	AC, IQ	$3,920	$7,900	$17,380
34	Malmstrom AFB, MT Underground High Temp HW Distribution System	AC, IQ	$10,000	$25,000	$25,000
35	Building Entrance Sleeve	IQ, AD	NQB	NQB	NQB
36	Deflection Detail for Top of Gypsum-board Walls	IQ, AC	$1,600	$7,537	$16,583
37	Verification of Existing Water Pressures and Flows	IQ, AC	$35,000	$17,500	$38,500
38	Water Flow Alarms, Electric vs. Water Motor	IS, AC	$2,250	$11,250	$11,250
39	Independent Building Commissioning Requirement	AD, LC	$562	$8,438	$18,562
41	Lead Based Paint Abatement Surveys and Quantities	AC, AD	$14,125	$28,250	$62,150
42	Room Signage	LC	NQB	NQB	NQB
45	Separate Ground Conductors for Dryers and Ranges	IS, AC	$1,000	$1,600	$3,630
50	Thickness of Joint Sealants	AC, AD, IQ	$7,500	$7,500	$16,500
51	QC/QA of As-Design Electronic Files	IQ, AC	$17,000	$34,000	$74,800
52	Sprinkler Branch Line Restraints	IS, AC	$750	$4,125	$9,075
53	Items to Mandate in Construction Project Schedules	IQ, AD	NQB	NQB	NQB
54	Repetitive Problems-Pipe & Duct Sleeves	IQ, AD	NQB	NQB	NQB
55	Cathodic Protection for Standpipes and Reservoirs	IQ, AC	$30,000	$50,000	$110,000
57	Horizontal Pipe Support Repetitive Problems	IQ, AD	NQB	NQB	NQB
58	Supports and Sway Bracing for Plastic Piping	IQ, AD	NQB	NQB	NQB
59	HVAC Ductwork Design Obligations	IQ, AC	$2,500	$5,000	$11,000
60	Masonry Sealer	IQ, AC	$2,150	$8,600	$18,920
61	Malmstrom AFB -- Fire Protection Rotating Red Beacon	IS, AC	$1,750	$3,500	$3,500
62	Flashing of Exit Signs during Fire Alarm	IS, AC	$8,625	$43,125	$94,875
63	Water Meters	AD, IQ	NQB	NQB	NQB
64	Water Meter Without DDC Output	AC, AD	$1,150	$2,300	$5,000
67	Backflow Prevention	AC, IQ	$900	$900	$1,980
71	400-Hertz Frequency Converters	AC, AD	$15,000	$20,000	$44,000
72	Building Occupancy Classification	AD, IQ			
74	Integrally Colored Sidewalks	IQ,AC	$10,525	$10,525	$23,155
	Total Savings				$671,870

Some lessons in Table 4-3 don't have a dollar value assigned to them because their greater value is of a qualitative nature, as in Lesson 53: Items to Mandate in Construction Project Schedules. This lesson in the database reads as follow:

LsnProblem Many times problems are occurring during the construction phase of a contract because the Contractor has not scheduled certain critical activities on his overall Project Schedule, so they are not actively tracked by all participants (Contractor and Government). This has led to delays in completion of jobs. Even if the Contractor's fault, this presents problems to us all.

LsnSolution There are certain activities on virtually every construction project that we should insist are separate line activities on a Contractor's project schedule (only those projects which require the use of a CPM versus a bar chart). Those items are as follows:

1) submission and approval of mech/elec layout drawings
2) submission and approval of O&M manuals
3) submission and approval of as-built drawings
4) submission and approval of 1354 date and installed equipment lists
5) submission and approval of testing and balancing and HVAC commissioning plans and data
6) air and water balance dates
7) HVAC commissioning dates
8) any other systems testing
9) prefinal inspection
10) correction of punchlist from prefinal inspection
11) final inspection

New Items recently required:
Air and Water TAB Firm Qualifications --- the certification of the proposed TAB firm's qualifications for either AABC or NEBB must be submitted not later than 21 DAYS AFTER THE NOTICE TO PROCEED! This TAB specialist must then submit a Design Review report not later than 14 days after the approval of the firm. This report requires the TAB specialist to review the plans and specs and notify the Government of any deficiencies that would prevent the HVAC system from effectively operating in accordance with the sequence of operation specified and/or prevent the effective and accurate TAB of the system. He must also review and approve all submittals that relate to TAB, which includes most equipment submittals.

Fire Protection now also has a requirement for a submittal of a Fire Protection Specialist not later than 14 days after the NTP! All work in accordance with the various fire protection systems must be supervised and certified by this person. There are very specific requirements for this person to be qualified.

The creator of this lesson thought that the above were good professional practices that will most likely save time and money down the road, even though there were not any specific incidents triggering this lesson. These types of lessons are referred to as "Best Practices" lessons and are denoted in Table 4-3 as non-quantifiable benefits (NQB).

The annual savings from using the lessons learned generated with CLL Phase 1 in the Seattle District is $671,870. This figure is 0.61% of the $110 million in new construction placed last year by this district. Moreover, this figure comes from the lessons only generated the first year. It is safe to assume that future years will bring new lessons and hence greater savings potential. Therefore, assuming a savings potential of 0.61% is very conservative.

Some lessons came from claims that also cause expenses to the Corps' customers. That is the case of Lesson Number 50. In that incident the runway was not operable for several weeks. As a consequence, the Air Force was unable to train pilots on Short Strip Assault because that was the only place available in the area for that training. It was estimated that between 4 and 5 pilots missed their training. Due to the difficulty of estimating the cost to the Air Force, this analysis reflects only the cost to the Corps of Engineers. However, this incident impacted the mission of the Air Force as well.

CLL Phase 2 Potential Savings

CLL Phase 2 improves the sharing of lessons learned among different groups of the organization. This improved sharing has two effects. First, it will speed up the generation of new lessons since similar design groups operating in different districts will now be able to share lessons learned easily. Second, other business processes will be able to access and also contribute to the lessons-learned database. An example of this process would be personnel in the procurement business process accessing the lessons of the engineering process and contributing to them. This cross-pollination between processes makes both business processes improve faster than they would otherwise.

For that to happen, CLL has to be added to other AISs. The cost to do so should be small but nevertheless, it is unknown and will be different for each AIS. Moreover, the benefits associated with sharing lessons between different business processes should outweigh that cost. However, at this point in time, it is beyond the control of the project manager and beyond the control of this analysis to estimate the timing and the intensity of that effect and hence it will not be estimated.

Even if that cross-pollination never materializes, it is still safe to assume that other districts would be able to benefit from the Seattle district lessons. That is to say, even if the other districts do not actively develop as many lessons of their own as the Seattle District did, people working in those districts with CLL Phase 2 should be able to access the engineering process lessons of all the other Corps Districts. So, it is safe to assume that, at the minimum, other districts can save the same percentage of their construction budget as Seattle can from using their own lessons. That is, even though some of the lessons generated in the Seattle District refer to local issues, it is reasonable to expect that other districts have local issues of their own that are of comparable in magnitude to those found at Seattle. In other words, the potential annual savings from using CLL Phase 2 Corps-wide is at least 0.61% of the Corps' new construction budget. This is a very conservative estimate since it does not account for the extra benefit that the Seattle District (and other districts) will obtain from using lessons generated in other districts.

The new construction budget for Military Construction Army (MCA) for FY01 is $1,460 Million and for Military Construction Air Force (MCAF) is $677 Million. A 0.61% of this is $13.04 Million. Assuming that the new construction budget for the next six years stays at the same level, the annual potential savings Corps-wide from using CLL Phase 2 would be $13 Million.

5. COMPARING COSTS AND BENEFITS

Introduction

The next step in the EA process is the comparison of cost and benefits to estimate the Savings-to-Investment Ratio (SIR) and the Discounted Payback Period (DPP) for each alternative. These comparisons were done using the ECONPACK 2.0 computer program*. Estimates were generated separately for Phase 1 and Phase 2.

Life Cycle Cost of CLL Phase 1 at Seattle District

The Life Cycle Cost (LCC) analysis for the Corporate Lessons-Learned Phase 1 over a 7-year period shows a

- Net Present Value of Savings of $2,807,959
- Net Present Value of Investment of $23,313
- Savings to Investment Ration (SIR) of 120.4
- Discounted Payback Period (DPP) of 2 years

The complete ECONPACK output for this analysis is in Appendix C.

Life Cycle Cost of CLL Phase 2

The Life Cycle Cost (LCC) analysis for the Corporate Lessons-Learned Phase 2 over a 7-year period shows a

- Net Present Value of Savings of $52,737,039
- Net Present Value of Investment of $375,261
- Savings to Investment Ration (SIR) of 140.5
- Discounted Payback Period (DPP) of 2 years

The complete ECONPACK output for this analysis is in Appendix D.

Sensitivity Analysis

This analysis was based upon the currently observer performance of CLL with DrChecks. By structuring the analysis this way, the issues identified in Chapter 3 (Identification of Constraints) were essentially controlled.

The analysis above assumes that all the lessons generated during the last year will be used during the next five years. This assumption is conservative because it was also assumed that no new lessons would be generated during the next five years. However, if only half of the lessons generated were used, the annual potential savings of CLL Phase 1 would be only $336,000 and the SIR would be 59.6. Moreover, if only a quarter of the lessons generated during the first year were reused during the next five years, the SIR would still be 28.

For both phases of CLL, the SIR is so large that it is unlikely that the Status Quo alternative would become the least-cost alternative. For Phase 1, for the Status Quo alternative to become the least-cost alternative, the expected savings would have to be reduced by 95%. In other words, CLL Phase 1 would be more expensive than the status quo if the expected annual savings in the Seattle District were

* ECONPACK 2.0, Economic Analysis Package, U.S. Army Corps of Engineers, Engineering and Support Center, Huntsville.

less than $27,000. That is unlikely since the average savings of the lessons in Table 4-3 is $33,600. In other words, by reusing just one average lesson for the next five years the SIR would be 3 and the DPP would be 3.6.

6. CONCLUSIONS AND RECOMENDATIONS

An economic analysis of the Corporate Lessons-Learned system was performed. The benefits of using this system were estimated by costing out the potential savings of the lessons developed at the Seattle District during the first year of the life of the system. Based upon the result of the analysis

- CLL Phase 2 can save USACE $53 Million during the first five years of operations.
- CLL Phase 1 will save the Seattle District $3 Million over the next 5 years.
- The expected SIR of this system is greater than 100.
- These estimates are conservative, and even if only one fourth of the lessons generated are used, the SIR would still be greater than 25.

More importantly, the use of CLL will increase the quality and operational safety of facilities delivered by the Corps.

CLL Phase 2 is still under development, and CLL Phase 1 has been used for less than one year. Therefore, this analysis needs to be updated at each major milestone in the development of CLL in order to test the accuracy and soundness of its assumptions.

Appendix A: Seattle District Lessons Learned Report

Seattle District Lessons Learned Database

PKeyLesson 30

IsApproved

LsnTitle Clarity of drawings

LsnProblem The line weight, lettering size need to be better than what's here and on other electrical drawings. Also, there is overlapping of letters and symbols. All this makes these, otherwise great, drawings hard to read. Improve in future.

LsnSolution Discuss at predesign

LsnCreatedBy Mr Anil Nisargand

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 31

IsApproved

LsnTitle CPVC Piping

LsnProblem Section 15569 does not contain a specific requirement for a piping material submittal. The requirement in Sections 15650 and 15895 is somewhat vague in that it requires a submittal on piping components.

The contractor submitted on copper pipe for the heating and chilled water systems (specifically identified as such) along with pipe identified for Section 15400. The submittal was approved. A subsequent submittal under Section 15400 proposed using CPVC pipe with no specific use stated. Since CPVC is allowed for plumbing systems, this submittal was approved. Thinking that they had approval to use CPVC pipe on any system, the contractor installed CPVC pipe aboveground for the heating and chilled water systems. The contractor failed to provide adequate support for the piping in accordance with the manufacturer's recommendations, was unaware of the requirement for sway bracing each support contained in Section 15083, and was unaware of the chemical and compatibility problem with propylene glycol antifreeze. The Contractor's QC and the Government QA did not catch the error until most of the piping was installed. Removal of the piping has caused a significant delay in the project.

LsnSolution In Sections 15569, 15650, and 15895, add a specific requirement for a pipe material submittal.

LsnCreatedBy Mr Greg Westmoreland

AssignedBy 71 Greg Westmoreland

AssignedTo 208 Liner-Arms Wendy

Approved By Schmidt

IsDenied

PKeyLesson 32

IsApproved

LsnTitle Drawing Scale Errors

LsnProblem The drawing scale needs to be verified on each design sheet. Simple scaling errors can result in large modifications, when scaling is all that can be relied upon for dimensioning. Problems can be compounded when drawings are reduced on a non uniform basis.

LsnSolution ALWAYS require bar scales on drawings in any illustration, map, figure, photo, etc as there is only nominal control over ultimate reproduction scale of the graphic involved.

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 33

IsApproved

LsnTitle Malmstrom AFB, MT Underground High Temp HW System

LsnProblem

LsnSolution

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 34

IsApproved

LsnTitle Malmstrom AFB, MT Underground High Temp HW Distribution System

LsnProblem This is a base specific item probably applicable to only Malmstrom AFB, MT, but a continuing problem with most designs at that base. The existing high temperature hot water distribution system throughout the base is not a direct burial system, but rather a system distributed inside buried concrete tunnels/vaults. The top of the vault is approximately 2 feet below grade and the bottom up to 6 to 7 feet below grade. On many designs, new utilities are shown passing over or in the vicinity of these HTHW lines and the designers simply assume they are direct buried pipes which can easily be passed over or under.

LsnSolution It is critical that all designers have the knowledge that the distribution system at Malmstrom AFB is contained within these underground concrete tunnels/vaults, that the top and bottom elevations of these vaults be verified, and proper design measures taken to pass other utilities or construction above or below these vaults.

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 35

IsApproved

LsnTitle Building Entrance Sleeve

LsnProblem On several recent projects, the fire service main to the building was installed without a sleeve in the floor and terminated with a mechanical joint without restraint rods.

NFPA 13 requires sleeves in floors with the sleeve diameter being 2" larger than the nominal pipe size for pipe 1" to 3-1/2" and 4" larger that the nominal pipe size for pipe 4" and larger.

CEGS 13930 requires fire amins to terminate 6" above finish floor with a flange and to be restrained using clamps and restraint rods. It also requires that plain-end fittings with mechanical couplings, fittings which use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used. This precludes using mechanical joints above ground for the main.

Often the water service to the building is installed by the utilities sub-contractor who has little knowledge of NFPA requirements and does not read Section 13930 of the specifications.

Prime contractors and CQC's are not coordinating the work.

LsnSolution Enforce existing specification requirements with the three part inspection system

LsnCreatedBy Mr Greg Westmoreland

AssignedBy 71 Greg Westmoreland

AssignedTo 208 Liner-Arms Wendy

Approved By Schmidt

IsDenied

PKeyLesson 36

IsApproved

LsnTitle Deflection Detail for Top of Gypsumboard Walls

LsnProblem Where gypsum board walls are run continuous to the structural deck above, they need to be provided with a means to deflect under live loads without breaking the gypsum board and/or deforming the wall studs.

LsnSolution There are details recommended by the US Gypsum Association which provide for the required deflection. These are in effect, 'slip tracks'. Manufacturers specifically make a top track to accommodate the deflection. It is necessary to make a 'deflection track' or a 'slip track' mandatory for use at the top of full height walls to the deck above, when that deck is subject to some deflection under loading.

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 37

IsApproved

LsnTitle Verification of Existing Water Pressures and Flows

LsnProblem In various fire protection specifications, normally the Contractor is given flow rates, and static and residual pressures from which to base his hydraulic design for fire protection systems. In several cases, this data has been incorrect, which in the worst case, has meant that the entire system designed and installed within a building has been underdesigned.

LsnSolution Add a requirement that the Contractor shall be required to conduct a flow and pressure test on the water system before he starts the design or any associated construction of fire protection systems.

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Westmoreland

IsDenied

PKeyLesson 38

IsApproved

LsnTitle Water Flow Alarms, Electric vs. Water Motor

LsnProblem Fire sprinkler drawings and specs sometimes contain discrepancies regarding the type of water-flow alarm required (e.g. specs have elec alarm, dwgs have water-flow alarm). Further, many Fire Dept's have a preference as to which type of alarm they like, and sometimes the drawings and/or specs show the incorrect type.

LsnSolution Show/require the type of water-flow alarm the respective Fire Dept's prefer. Coordinate specs and dwgs accordingly.

LsnCreatedBy Mr Steve Dodroe

AssignedBy 0

AssignedTo 0

Approved By Westmoreland

IsDenied

PKeyLesson 39

IsApproved

LsnTitle Independent Building Commissioning Requirement

LsnProblem As currently written, the guide specification for Commissioning of HVAC systems requires a commissioning team to be comprised of Government representatives, a design agent representative, and various members of the Contractor's team, to include his QC Manager. This can lead to either a quality problem as the Contractor's team is largely compromised of the people who performed the actual work and thus are not as objective as they can or should be. A further quality problem is that normally none of these personnel are "expert" in HVAC commissioning and thus things can be overlooked. Often times, an adversarial relationship is encountered. Overall the impact is a facility that is that commissioned as intended and problems are still occurring after owner occupancy; thus causing Customer dissatisfaction.

LsnSolution Change the guide specification to state that the HVAC system shall be accepted only after it has been tested, balanced, AND commissioned by an INDEPEDENT and qualified firm or agency specializing in such work. We could even require minimum experience (i.e.--shall have commissioned at least 3 buildings of comparable size and complexity)

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Westmoreland

IsDenied

PKeyLesson 41

IsApproved

LsnTitle Lead Based Paint Abatement Surveys and Quantities

LsnProblem Lead Based Paint Surveys are being taken during the design stage for projects that involve rehabilitation of existing facilities. However, the actual survey report itself is not consistently being included within the contract documents as a reference document. Often times, estimated quantities of abatement are provided. On several occasions, the estimated quantities have been significantly less than the actual quantities that must be abated. This results in modifications to the contract that are normally very costly, and use available contingency monies right at the beginning of a project. This then affects the entire remainder of the project when that contingency money cannot be replenished.

LsnSolution ALWAYS include the actual hazardous material surveys (whether lead based paint or asbestos or any material) as a reference document within the contract. Do NOT put estimated quantities of removal within the contract unless it cannot be expected the Contractor can do quantity take offs from the information available within the contract, to include the drawings and the actual hazardous material surveys.

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 42

IsApproved

LsnTitle Room Signage

LsnProblem Quite often, the Room Numbers shown on the final design drawings for construction do not match up with the final Room Signage schedule in the design for the occupant of the building. This creates a lot of confusion and problems, both during construction and after occupancy. For example, on all power panels, the Contractor is required to identify specific circuits for specific rooms. If he identifies them according to the room numbers of the final design drawings, they don't match with the numbers of the posted room number signs. If he identifies them according to the posted room number signs (per the design Signage Schedule), they don't match up with the as-built construction drawings, causing confusion with future work within that facility.

LsnSolution Require that final design room numbers on the construction drawings match final design room signage numbers.

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 43

IsApproved

LsnTitle Room Signage

LsnProblem Quite often, the Room Numbers shown on the final design drawings for construction do not match up with the final Room Signage schedule in the design for the occupant of the building. This creates a lot of confusion and problems, both during construction and after occupancy. For example, on all power panels, the Contractor is required to identify specific circuits for specific rooms. If he identifies them according to the room numbers of the final design drawings, they don't match with the numbers of the posted room number signs. If he identifies them according to the posted room number signs (per the design Signage Schedule), they don't match up with the as-built construction drawings, causing confusion with future work within that facility.

LsnSolution Require that final design room numbers on the construction drawings match final design room signage numbers.

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 44

IsApproved

LsnTitle Grounding of Ranges and Dryers

LsnProblem

LsnSolution

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 45

IsApproved

LsnTitle Separate Ground Conductors for Dryers and Ranges

LsnProblem Some designs are still allowing shared neutral and grounding conductors for dryers and ranges. This changed in the 1996 NEC wherein separate grounding conductors are required in addition to neutral conductors. The 1999 NEC references are 250-138 and 250-140

LsnSolution Ensure all designers are aware of and comply with the latest NEC such that dryers and ranges are required to have separate grounding and neutral conductors

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 48

IsApproved

LsnTitle Joint Sealing

LsnProblem When we're not looking, joint sealant subcontractor changes his quality standards.

LsnSolution QA reg should require "surprise" follow-up inspections by COE QA inspector.

LsnCreatedBy Mr Jeff Juel

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 49

IsApproved

LsnTitle Insulated Metal Wall Panel Appearance Unsatisfactory

LsnProblem Reference Specification Section 07420, Plate A3.01, Contract 99-C-0026, Flightline Support Facility. When this material is applied over large spans(40'), the variations in surface contour present an unsatisfactory profile as judged by the Air Force BCE representatives. We think this is due to light gage(26)(0.55mm)and lack of significant profile(embossed stucco pattern with linear striations[corrugated]) to break up the viewing plane. The same complaint applied to the Maintenance Training Facility, 97-C-0024.

LsnSolution We recommend using 22 gage steel sheets with embossed stucco pattern with step or channel shaping. __/--__/--__/ . The gage and the shaping provides more rigidity to the panels and break up the viewing plane. Confirm with Matt Kitterman, BCE Architect @ 253-984-3537, McChord AFB. The Clinic Replacement Project(99-C-0028) specified the 22 gage material, kept the same profile, and used the panels on shorter spans. The Consolidated Medical Training Facility(99-C-0065) did not specify gage at all but we have required that contractor to provide 22 gage

LsnCreatedBy Mr Richard Watts

AssignedBy 0

AssignedTo 0

Approved By Nakamoto

IsDenied

PKeyLesson 50

IsApproved

LsnTitle Thickness of Joint Sealants

LsnProblem A major failure recently occurred on a runway with field molded joint sealants. The problem was a lack of thickness of sealant over the top of the backer rod which caused and had the potential to cause premature failure due to decreased abrasion resistance, puncture resistance, and other factors. An after the fact review revealed a problem among both Contractor QC and Government QA personnel in regard to where the minimum thickness required should be obtained --- over the top of the backer rod or at the sides of the joint (where the thickness would be greater due to rounded shape of the backer rod in the joint)

LsnSolution During the construction preparatory phase of Quality Control for joint sealants, all involved in a project need to be aware of either contract or manufacturer minimum thickness requirements for field molded joint sealant, that this minimum thickness is measured from over the top of the backer rod, and that premature failures of the sealant may take place unless this requirement is strictly adhered to. Discussions need to take place at the preparatory stage as to how this minimum thickness will be verified.

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 51

IsApproved

LsnTitle QC/QA of As-Design Electronic Files

LsnProblem Immediately after the construction NTP, most Contractors have an immediate need for the as-designed electronic files. They use them not only for the continuing process of updating their as-builts, but for preparation of shop drawings as well. In more than a few cases, problems have been found with those electronic files. The problems range from things such as certain drawings not included on the files, the drawing files not matching the plotted bid/contract sets, certain layering missing, certain reference files missing, special fonts missing, and similar problems. This has caused delays as well as Contractor claims for cost associated with the effort of trying to correct the files.

LsnSolution The solution is to insist upon by a Quality Control check of the as-designed files by the designer of record (put it right in the A/E contract) and require a very specific acknowledgement that the QC check has been performed. Then there must be a specific Government Quality Assurance check of the files before they are passed onto the Contractor, with again, a very specific statement that the QA check has been performed. Finally, the specifications should be revised to require that the Contractor then check the as-design files that he receives from the Government and provide any comments back within say 30 days, or he assumes responsibility for their completeness and accuracy.

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 52

IsApproved

LsnTitle Sprinkler Branch Line Restraints

LsnProblem Sprinkler designers and installers frequently do not provide restraints for the end sprinkler on a line.

In past contracts, Section 15330 required end sprinkler restraints and such restraints have been an NFPA 13 requirement since 1994.

The new Fire Protection Specification Sections 13930, 13935, 13945, and 13955 do not include a specific requirement for end of line restraints but do reference NFPA 13 for such restraints. NFPA 13, 1999 states:

6-4.6 Restraint of Branch Lines. 6-4.6.1* Restraint is considered a lesser degree of resisting loads than bracing and shall be provided by use of one of the following: (1) A listed sway brace assembly, (2) A wraparound U-hook satisfying the requirements of 6-4.5.3, Exception No. 3, (3) No. 12, 440-lb (200-kg) wire installed at least 45 degrees from the vertical plane and anchored on both sides of the pipe, (4) Other approved means Wire used for restraint shall be located within 2 ft (610 mm) of a hanger. The hanger closest to a wire restraint shall be of a type that resists upward movement of a branch line. 6-4.6.2 The end sprinkler on a line shall be restrained against excessive vertical and lateral movement. 6-4.6.3* Where upward or lateral movement would result in an impact against the building structure, equipment, or finish materials, branch lines shall be restrained at intervals not exceeding 30 ft (9 m). 6-4.6.4* Sprig-ups 4 ft (1.2 m) or longer shall be restrained against lateral movement.

LsnSolution Ensure that Fire Protection Drawing Submittals include a detail for the end of line bracing and show the locations on the floor plans. During construction, ensure that the installer provides the restraints in accordance with the approved drawing details.

LsnCreatedBy Mr Greg Westmoreland

AssignedBy 110 Steve Dodroe

AssignedTo 266 Lie Sven

Approved By Schmidt

IsDenied

PKeyLesson 53

IsApproved

LsnTitle Items to Mandate in Construction Project Schedules

LsnProblem Many times problems are occurring during the construction phase of a contract because the Contractor has not scheduled certain critical activities on his overall Project Schedule, so they are not actively tracked by all participants (Contractor and Government). This has led to delays in completion of jobs. Even if the Contractor's fault, this presents problems to us all.

LsnSolution There are certain activities on virtually every construction project that we should insist are separate line activities on a Contractor's project schedule (only those projects which require the use of a CPM versus a bar chart). Those items are as follows: 1) submission and approval of mech/elec layout drawings 2) submission and approval of O&M manuals 3) submission and approval of as-built drawings 4) submission and approval of 1354 date and installed equipment lists 5) submission and approval of testing and balancing and HVAC commissioning plans and data 6) air and water balance dates 7) HVAC commissioning dates 8) any other systems testing 9) prefinal inspection 10) correction of punchlist from prefinal inspection 11) final inspection

New Items recently required: Air and Water TAB Firm Qualifications --- the certification of the proposed TAB firm's qualifications for either AABC or NEBB must be submitted not later than 21 DAYS AFTER THE NOTICE TO PROCEED! This TAB specialist must then submit a Design Review report not later than 14 days after the approval of the firm. This report requires the TAB specialist to review the plans and specs and notify the Government of any deficiencies that would prevent the HVAC system from effectively operating in accordance with the sequence of operation specified and/or prevent the effective and accurate TAB of the system. He must also review and approve all submittals that relate to TAB, which includes most equipment submittals.

Fire Protection now also has a requirement for a submittal of a Fire Protection Specialist not later than 14 days after the NTP! All work in accordance with the various fire protection systems must be supervised and certified by this person. There are very specific requirements for this person to be qualified.

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 54

IsApproved

LsnTitle Repetitive Problems-Pipe & Duct Sleeves

LsnProblem During the course of construction, repetitive type problems are being found with pipe and duct sleeves. Part of the problem is a lack of awareness of contractor and Government personnel of the requirements common to every contract.

LsnSolution The following Repetitive Construction Deficiencies need to be specifically discussed at preparatory phase inspections with Contractors:

Pipe and Duct Sleeves:

1. In all cases, sleeves are to be installed when the wall or floor is constructed and not core drilled after construction. Core drilling weakens the construction and drilled holes are difficult to seal

2. Fire Protection Piping must be sleeved through all walls and floors and provided with 1" clearance between the pipe and sleeve. The exception to this is piping passing through frangible (sheet rock) walls that are NOT fire rated. These requirements are stated in 15330 (or other fire protection spec sections as applicable) and in NFPA 13, Paragraph 4-14.4.3.4. a. CMU and concrete walls or floor require sleeves to prevent breaking the pipe during an earthquake. b. Sleeves are required in frangible fire rated walls to prevent pipe movement or wall movement during an earthquake from destroying the fire seal and fire rating of the wall.

3 Insulated domestic water, refrigerant piping, hot water, and chilled water piping must be sleeved through all masonry or concrete walls and floors. Pipe insulation is to be continuous through ALL walls and floors. Where wall or floor penetration requires sealing for water, fire rating, smoke rating, sound rating, or any other seal requirement, the insulation on the pipe shall be covered with aluminum jacket extending 2" on either side of the penetration. a. The Aluminum jacket provides a surface for the sealing material to attach while still allowing for pipe expansion and contraction without damaging the seal or tearing the insulation. b. The jacket also allows for continuous insulation through the seal, which reduces heat loss or gain. The jacket allows the vapor barrier to remain intact and keeps water vapor out of the insulation reducing the chance of condensation drips and damaged ceilings.

4. Duct sleeves or framed prepared openings are required for all ducts by 15895 2.8.4. Sleeves or prepared openings are to provide 1"clearance to the duct insulation and to be closed-off with closure collars (15895 2.8.4.3). Fire and smoke dampers are sleeved in accordance with 15895 2.8.3.2. a. Sleeves and framed openings for ductwork are to insure that duct insulation is continuous through all walls and floors and vapor barriers remain intact. b. At walls or floors having fire or smoke dampers, ductwork and insulation are not continuous through the damper.

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 55

IsApproved

LsnTitle Cathodic Protection for Standpipes and Reservoirs

LsnProblem CEGS 13206 allows for Steel Standpipes and Ground Storage Reservoirs to utilize either bolted or welded construction. Standpipes or reservoirs may be required to have cathodic protection. There is no problem cathodically protecting a (coated) welded tank because it is electrically continuous, but cathodic protection is not compatible with the majority of brands of bolted tanks since the plates are not electrically continuous with one another. Since bolted tanks are roughly 2/3 the cost of welded tanks, bolted tanks will typically be provided when a contract allows for them. It should be noted that applying cathodic protection to most brands of coated bolted tanks will actually diminish their design life since the plates are electrically isolated (discontinuous). It should also be noted that the design life for bolted tanks is often substantially less than for welded tanks.

LsnSolution For designs with standpipes or storage reservoirs, ensure that CEGS 13206 is carefully edited in conjunction with, and consistent with, the cathodic protection spec if cathodic protection is to be required. Particular care must be exercised when bolted tanks are allowed.

LsnCreatedBy Mr Steve Dodroe

AssignedBy 110 Steve Dodroe

AssignedTo 87 Brown Art

Approved By Schmidt

IsDenied

PKeyLesson 57

IsApproved

LsnTitle Horizontal Pipe Support Repetitive Problems

LsnProblem Horizontal Pipe Supports

On numerous jobs, the spacing of hangers and supports for piping exceeds that required by our specifications.

15400 3.1.8.3.i, states: "Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 12" form ether pipe fitting joint at each change of direction of the piping. Pipe supports shall be spaced not over 5' apart at valves."

15488, 3.12 requires gas piping to be supported in accordance with NFPA 54. Supports will be closer together than shown in MSS SP 69.

15569 3.2.10.3.g, repeats the requirements of 15400.

15650 3.1.2.7.g, repeats the requirements in 15400.

When various size pipe is grouped on a trapeze, the trapeze spacing is dictated by the smallest pipe in the group.

Nominal	Sch 40 Steel		Copper Tube	
Size	Water (ft)	Vapor (ft)	Water (ft)	Vapor (ft)
1/2	7	8	5	6
3/4	7	9	5	7
1	7	9	6	8
1-1/4	7	9	7	9
1-1/2	9	12	8	10
2	10	13	8	11
2-1/2	11	14	9	13
3	12	15	10	14
3-1/2	13	16	11	15
4	14	17	12	16
6	17	21	14	20
8	19	24	16	23

Cast Iron --Support at every joint, wye, and change of direction

Plastic Piping -- See Manufacturer's requirements

LsnSolution Specifically discuss requirements for pipe supports at preparatory inspections

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 58

IsApproved

LsnTitle Supports and Sway Bracing for Plastic Piping

LsnProblem Support and Sway Bracing for Plastic Pipe

CEGS 13083, 3.5: "Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 15400, Plumbing, General Purpose. Bracing shall consist of at least one vertical angle 2 x 2 x 16 gauge and one diagonal angle of the same size."

CEGS 15400, 3.1.8.3.i: "Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction."

MSS SP-69, Table 3, Maximum Horizontal Pipe Hanger and Support Spacing, Column 9 for plastic pipe states: "Follow pipe manufacturer's recommendations for material and service condition."

For a typical schedule 80, 1-1/2" domestic hot water line of CPVC, George Fisher Piping requires a maximum 3-1/2 feet between hangers and supports. Supports must be closer than 3-1/2 feet if the pipe is insulated due to the additional weight. Hanger spacing for steel 1-1/2" is 9 feet and spacing for type L copper is 8 feet. A minimum of one sway brace is required for each pipe run.

For Zone 2B, sway bracing for 1-1/2" pipe is required as follows:

Steel Schedule 40	every 30 feet
Type L copper	every 15 feet
CPVC Schedule 80	every 3-1/2 feet

One other thing to be aware of. For our normal contracts, we allow the using of plastic piping ONLY for domestic hot and cold water lines, NOT for hot water heating or chiller water lines.

LsnSolution Discuss the specific requirements for the support and sway bracing of plastic piping at preparatory inspections.

LsnCreatedBy Mr. Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson 59

IsApproved

LsnTitle HVAC Ductwork Design Obligations

LsnProblem Designs continue to be forwarded which are not complete or in accordance with the Guide Specifications. The Guide Specifications clearly require that the designer must note on the drawings the appropriate pressure classification from the SMACNA HVAC Duct Construction Guide, including points of changes in the pressure classifications. This is not be consistently done. In a related matter, the specifications are not being properly edited for ductwork leakage testing. The Guide Specs state that the paragraph on this leakage testing (15895-3.4) may be omitted when the ductwork is constructed to static pressure classes of 2 inches or less water gage. This represents most of our ductwork on projects. However IF the designer decides that leakage testing is justified, he is then obligated to specify the amount and manner of leakage testing and clearly indicate acceptance criteria. The SMACNA manual for HVAC Air Duct Leakage Test Manuals states that when the designer merely requires leakage testing to be conducted in accordance with this SMACNA manual, he is deemed not to have fulfilled his responsibilities for providing a clear scope of work, therefore "any implied obligation of the installer to fulfill the responsibilities in regard to leakage are deemed waived by defective specification". Contractors quote this from SMACNA and disputes are resulting in the field.

LsnSolution As part of a designer Quality Control check and as a part of Government Quality Assurance check of any design, should be a specific checklist item to verify that the pressure classification of ductwork is clearly indicated on the drawings and to ensure that if ductwork leakage testing is required, the amount and manner of testing is specified as is the acceptance criteria.

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Westmoreland

IsDenied

PKeyLesson 60

IsApproved

LsnTitle Masonry Sealer

LsnProblem On design/build projects with masonry, very often in the RFP there is no requirement to seal the units. This allows water absorption which promotes unsightly efflorescence.

LsnSolution Ensure the RFP has a specific requirement to seal the exterior of masonry units with a silane or siloxane based sealer with a solids content of 20% minimum.

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Schmidt

IsDenied

PKeyLesson	61
IsApproved	
LsnTitle	Malmstrom AFB -- Fire Protection Rotating Red Beacon
LsnProblem	This is a Lessons Learned which is specific to Malmstrom AFB, MT only. The base has a local requirement for a rotating red beacon, on the exterior of buildings, closest to main access roads, to depict a building in an alarm condition.
LsnSolution	Add the requirement for such a rotating red beacon to all design requirement documents for Malmstrom AFB. MT
LsnCreatedBy	Mr Dean Schmidt
AssignedBy	71 Greg Westmoreland
AssignedTo	87 Brown Art
Approved By	Schmidt
IsDenied	

PKeyLesson	62
IsApproved	
LsnTitle	Flashing of Exit Signs during Fire Alarm
LsnProblem	There are ADA requirements for exit signs to flash during fire alarm. The flashing provision in the exit signs is sometimes not called out in the exit sign fixture description. Also, the fire alarm specs and/or riser diagram sometimes do not indicate the requirement for the interface between the fire alarm control panel and the exit signs.
LsnSolution	When the exit signs in a facility are required to flash during a fire alarm, ensure the exit sign fixture description, the fire alarm spec, the fire alarm riser, and the fire alarm matrix all indicate this requirement. Further, the lighting drawings should contain a reference to this requirement.
LsnCreatedBy	Mr Steve Dodroe
AssignedBy	71 Greg Westmoreland
AssignedTo	87 Brown Art
Approved By	Schmidt
IsDenied	

PKeyLesson 63

IsApproved

LsnTitle Water Meters

LsnProblem On several recent projects water meters have been shown in design documents on water services over 2"in diameter. The CEGS specification for water meters, 15400 2.15, only provides for AWWA ANSI/AWWA C700 positive displacement type meters. C700 meters are available up to 2" size. For meters on services over 2" turbine type meters, AWWA C701, should be specified.

LsnSolution Change the guide specifications to include AWWA C701 meters for services over 2" in size.

LsnCreatedBy Mr Greg Westmoreland

AssignedBy 71 Greg Westmoreland

AssignedTo 266 Lie Sven

Approved By Schmidt

IsDenied

PKeyLesson 64

IsApproved

LsnTitle Water Meter Without DDC Output

LsnProblem When the water meter is outside the building - Civil - the specification is not coordinated with the DDC monitoring requirements. Interior Plumbing, 15400, will correctly specify the pulse output requirement, but this is not applicable when the meter is more than 5' outside the building. Even when a pulse output is specified and the meter is in the building - there is confusion as to a tie to DDC or merely a remote readout.

LsnSolution Have a standard paragraph for the AE to use, in 02660, when the water meter is outside the 5' building line and the pulse monitoring is required for Base DDC.

If remote readout is required - show on the plans the desired mounting point - and say that the remote readout is in addition to the DDC connection.

LsnCreatedBy Mr Richard Watts

AssignedBy 72 Dean Schmidt

AssignedTo 71 Westmoreland Greg

Approved By Westmoreland

IsDenied

PKeyLesson 65

IsApproved

LsnTitle Water Infiltration

LsnProblem All of the barracks constructed under the 95 through 98 projects have multiple problems with the precast concrete copings (attachment, leakage, etc.). Would be a good idea to eliminate the precast copings and install sheet metal caps instead. This would eliminate leakage problems and future maintenance headaches. This comment is intended for all future buildings (Company, Brigade Headquarters, Battalion Headquarters, Barracks, Dining Facilities, etc.).

LsnSolution

LsnCreatedBy Mr Ted Lewis

AssignedBy 72 Dean Schmidt

AssignedTo 225 Nakamoto James

Approved By

IsDenied

PKeyLesson 66

IsApproved

LsnTitle Boiler Flame out (Related to undersized supply)

LsnProblem Gas supply piping was undersized on the company buildings for the FY95 through FY98 Whole Barracks Projects. Need to take a second look at the gas supply issues for future buildings so that boiler/water heater flame out is not an issue.

LsnSolution

LsnCreatedBy Mr Ted Lewis

AssignedBy 0

AssignedTo 0

Approved By Lie

IsDenied

PKeyLesson 67

IsApproved

LsnTitle Backflow Prevention

LsnProblem Designer Note No.6 states "Show the location of the backflow preventer (including provisions for a drain and access for maintenance) where the potable water supply system is at risk of contamination by the sprinkler system on the drawings." This may give the designer the impression that backflow prevention devices are not required on all fire protection systems.

Section 10.5.9 of the National Standard Plumbing Code (1966) requires backflow prevention devices on all fire protection systems.

LsnSolution Change the designer notes in Section 13930 to require installation of backflow preventers in accordance with the National Standard Plumbing Code.

LsnCreatedBy Mr Greg Westmoreland

AssignedBy 0

AssignedTo 0

Approved By Lie

IsDenied

PKeyLesson 68

IsApproved

LsnTitle Fire Alarm O&M & Training vs. General O&M Requirements

LsnProblem 01701-3.2.3 requires APPROVED/FINAL O&M's prior to scheduling training. 16721-SD-19 requires DRAFT O&M's 15 days prior to final acceptance tests. 16721-3.5 states that the training period shall start PRIOR to final acceptance tests.

These fire alarm requirements are incompatible with the basic O&M requirement which requires final O&M's prior to training which is required to precede testing.

McChord AFB will not attend training without reviewing the APPROVED O&M's &

LsnSolution Revise fire alarm spec to require FINAL APPROVED O&M's prior to scheduling training.

LsnCreatedBy Mr Richard Watts

AssignedBy 0

AssignedTo 0

Approved By Westmoreland

IsDenied

PKeyLesson 69

IsApproved

LsnTitle Fire Alarm O&M & Training vs. General O&M Requirements

LsnProblem 13850 & 13851 are not being used! I'm reviewing PQWY99-3051 FY01 right now and it is using the same McChord fire alarm specs (16721M1 and 16721M2) for the 35% & 65% design stage. PM is Ron McMullen. If there is a new spec - who is directed to use it and when?

, 01701-3.2.3 requires APPROVED/FINAL O&M's prior to scheduling training. 16721-SD-19 requires DRAFT O&M's 15 days prior to final acceptance tests. 16721-3.5 states that the training period shall start PRIOR to final acceptance tests.

These fire alarm requirements are incompatible with the basic O&M requirement which requires final O&M's prior to training which is required to precede testing.

McChord AFB will not attend training without reviewing the APPROVED O&M's & therefore the fire alarm spec requires revision. ***This Lesson Resubmitted. Original Lesson Number 68 D Is Approved By Mr Greg Westmoreland (voice: 509-244-5571, email greg.westmoreland@usace.army.mil) on 20-Jun-00***

LsnSolution Revise fire alarm spec to require FINAL APPROVED O&M's prior to scheduling training.

LsnCreatedBy Mr Richard Watts

AssignedBy 71 Greg Westmoreland

AssignedTo 72 Schmidt Dean

Approved By Schmidt

IsDenied

PKeyLesson	70
IsApproved	
LsnTitle	Floor Drains, Vertical Clearance
LsnProblem	Reference floor drains in mechanical room for 4 inch diameter waste pipe. There is insufficient space between the floor slab and the waste line at the upper end of the sloped line to install a floor drain and long radius elbow as required. This usually requires 18 to 24 inches of drop for a 4 inch drain. Check other floor drains down slope.
LsnSolution	Include detail of floor drain showing components (including long radius elbow), and dimensions. Verify that worst case can accommodate the dimensions required.
LsnCreatedBy	Mr Hank Payne
AssignedBy	0
AssignedTo	0
Approved By	
IsDenied	

PKeyLesson 71

IsApproved

LsnTitle 400-Hertz Frequency Converters

LsnProblem Most air bases (Army, Air Force, Navy) use 400-hertz frequency converters to supply ground power for aircraft and aircraft equipment. Frequently these converters are Gob’s-furnished, Contractor-installed (GFCI) items. There have been many instances in which the converters have not been procured by the Gob’s in time for installation by the Contractor. There have been other instances in which the wrong capacity converter has been furnished by the Govt. Both situations cause additional contract costs, resulting from either completion delays or expensive electrical system modifications.

This problem occurs on both design-bid-build and design-build projects.

LsnSolution Delays/costs could be mitigated if frequency converters were Contractor-furnished, Contractor-installed (CFCI) items.

If CFCI is not an option, it is imperative that the Gob’s agency responsible for selecting and ordering the converter(s) ensures that it is correctly specified (capacity and input/output voltages) and available to the Contractor well before the contract-completion date.

LsnCreatedBy Mr Steve Dodroe

AssignedBy 0

AssignedTo 0 proved By Schmidt

IsDenied

PKeyLesson 72

IsApproved

LsnTitle Building Occupancy Classification

LsnProblem Section 3.7, fire protection and life safety. For construction purposes it would be a good idea to include the occupancy type to be placed on the G-1 drawing plate. This gives the correct design info to those who do not normally have access to the DA. (Includes construction branch).

LsnSolution List the fire protection and life safety information on drawing plates. Pertinent info for building contractors and construction staff only. Not for general review. For review purposes the full text needs to be described in the Fire Protection and Life Safety Section.

LsnCreatedBy Mr James Nakamoto

AssignedBy 0

AssignedTo 0

Approved By Shaw

IsDenied

PKeyLesson	73
IsApproved	
LsnTitle	NFPA 780 - Lightning Protection
LsnProblem	Current discussion by NFPA indicates that the 2000 edition of NFPA 780 may not be released. There is also discussion that the 1997 edition may be retroactively rescinded. The NFPA July 18-20 Standards Council meeting minutes indicates that there may be insufficient scientific data/evidence to support the lightning-protection methodology prescribed in NFPA 780.
LsnSolution	If NFPA decides to delete 780 (whether 2000, 1997, or both editions), manuals/regs/specs which currently utilize & reference NFPA 780 will need to be revised/edited accordingly. Lightning-protection designs or design criteria will need to be based upon criteria other than from NFPA 780.
LsnCreatedBy	Mr Steve Dodroe
AssignedBy	110 Steve Dodroe
AssignedTo	87 Brown Art
Approved By	
IsDenied	

PKeyLesson 74

IsApproved

LsnTitle Integrally Colored Sidewalks

LsnProblem A serious problem occurred on a recent job which required integrally colored concrete. The end product as installed left a very uneven and "mottled" looking concrete, which was not acceptable to anyone. Upon further investigation, it was found that the Contractor had cured the walks using visqueen and/or blankets, which was a primary cause of the problem.

LsnSolution The preferable solution is to not design any integrally colored concrete into any project, because despite the tightest of Quality Control, the "evenness" of the color will vary and its acceptability is very subjective.

However, if integrally colored concrete is required, it is critical that manufacturer recommendations be closely reviewed, specified, and followed. Manufacturers do NOT recommend water curing or covering the walks with any material such as blankets or visqueen or similar during curing because it will promote "discoloration" or "unevenness" of color. All manufacturers that I am aware of very specifically recommend their own colorless or colored spray on curing compound.

LsnCreatedBy Mr Dean Schmidt

AssignedBy 0

AssignedTo 0

Approved By Butler

IsDenied

PKeyLesson 75

IsApproved

LsnTitle Pit Valves for Containment Drains

LsnProblem Where pit or vault valves are utilized for routine drainage of rain water from fuel spill containments - the operators will not be lifting vault lids (flat plates on this project) to keep the valves in the "spill-safe" position. The valves have to be positioned to direct flow to an oil/water separator if the area has only surface or rain water OR to a containment tank if there has been a fuel spill. Both valves are shown to be normally closed for a timely determination of water quality.

LsnSolution Where routine operation of a valve is required it needs to be a "specially marked" post indicator valve or located in a vault with a spring assist lid. This will allow and encourage proper routine operations and protect against separator overload and sewer system contamination where valves are left in the incorrect positions.

LsnCreatedBy Mr Richard Watts

AssignedBy 485 KathleenKunz

AssignedTo -1

Approved By

IsDenied

PKeyLesson 76

IsApproved

LsnTitle Truck Loading Station Containment Doesn't Match Piping

LsnProblem The containment area for the truck loading and hydrant hose truck checkout station was not matched to the piping for these areas.

LsnSolution We had to extend both areas 10' to allow installation of the piping within the containment area.

LsnCreatedBy Mr Richard Watts

AssignedBy 0

AssignedTo 0

Approved By

IsDenied

PKeyLesson	77
IsApproved	
LsnTitle	Storage Tank Plug and Hi-Level Valves Bolted Together
LsnProblem	When the fuel storage tank plug valve and high level valves are bolted together (as shown on the typical type III system) the high level valve (CLA-VAL) cannot be removed without draining the storage tank and also removing the plug valve.
LsnSolution	Provide a spool and pressure relief between the tank plug valve and the high level control valve to permit removal of the control valve without draining the tank.
LsnCreatedBy	Mr Richard Watts
AssignedBy	0
AssignedTo	0
Approved By	
IsDenied	

PKeyLesson 78

IsApproved

LsnTitle Relieve Emergency Shut-off Valve to Product Recovery Drain

LsnProblem The emergency shut-off valve in the current type III system design does not maintain sufficient flow pressure at pump shutdown to cause valve closure within 10 seconds. The piping at the valve location has a higher head at the discharge than at the inlet and insufficient flow differential pressure remains after pump shutdown to drain the pilot valve bonnets.

LsnSolution Since the emergency stop signal shuts off the pumps at the same time the valve closure signal is sent to the valve - the relief from the bonnets of the pilot valves need to discharge to a product recovery drain line to allow quick closure of the emergency shutoff valve. This will only dump about a cup of fuel for every operation and will assure quick action. CLA-VAL has endorsed this fix & it should be shown on the drawings so that the proper taps are installed during construction to make the drain connections.

LsnCreatedBy Mr Richard Watts

AssignedBy 0

AssignedTo 0

Approved By

IsDenied

PKeyLesson	79
IsApproved	
LsnTitle	Fuel Resistant Gaskets and Link Seals
LsnProblem	Where storm drains and catch basins serve fuel containment areas - they have standard gaskets and link seals which will break down and leak fuel into the soil.
LsnSolution	Provide fuel resistant gaskets and link seals so that exposure to fuels will not break down the seals and allow leakage to the soil when/if a major spill occurs.
LsnCreatedBy	Mr Richard Watts
AssignedBy	0
AssignedTo	0
Approved By	
IsDenied	

PKeyLesson 80

IsApproved

LsnTitle Clean Fuel Supply Line and Commission

LsnProblem When a new fuel system is to be filled by an existing/idle fuel line - fuel contamination of the new facility will occur unless the lines are cleaned, flushed and commissioned as a part of the whole system. The standard type III system specs do not address the cleanup of the fuel transfer line.

LsnSolution Include in the commissioning specifications and drawing notes - a description of the cleaning procedures and flushing/testing required to clean an existing/idle fuel fill line so that when the new system is brought on line it is fully functional with aircraft quality fuel in all lines and tanks.

LsnCreatedBy Mr Richard Watts

AssignedBy 0

AssignedTo 0

Approved By

IsDenied

PKeyLesson 81

IsApproved

LsnTitle Provide Valve Tags for System Valves

LsnProblem The specification did not require valve tags to match the system drawings and the valve sequences to sectionalize the system per the specified sequences. Valve tags reduce errors in setup and are required by AF operations staff.

LsnSolution Provide valve tags for sectionalizing and control valves per the FLOW DIAGRAM and VALVE CHART. (There have been differences between the system isometric piping drawings and the flow chart.)

LsnCreatedBy Mr Richard Watts

AssignedBy 0

AssignedTo 0

Approved By

IsDenied

PKeyLesson 82

IsApproved

LsnTitle Allowance for Rack Flow in Building Sprinkler Design - Flightline Support

LsnProblem For a Flightline Support Facility with follow-on installation of storage racks and in-rack fire protection - the requirements for rack sprinkler design and flow were not incorporated with the building fire requirements. This left the building service and sprinkler mains undersized to serve the follow-on requirements. The follow-on contract had to be delayed and modified to achieve satisfactory coverage (density). Rack storage affects the density requirement for ceiling heads - and requires separate service & isolation - not just branches from building mains.

LsnSolution The total sprinkler system must be designed with connections and flow rate allowances for the follow-on system in the building design with reference to the density requirements of a structure with racks NFPA 231C - not just Mil Hdbk 1008C and NFPA 13. High temperature heads may be required at the ceiling to reduce the density requirements.

LsnCreatedBy Mr Richard Watts

AssignedBy 0

AssignedTo 0

Approved By

IsDenied

Appendix B: Estimation of Benefits of Approved Lessons Learned in the Seattle District

Lesson # 31: CPVC Piping:

This lesson resulted from a major contract dispute that is still under consideration. The contractor was forced to take the CPVC pipe out and put steel pipe in. He/she filed a claim for $157,000. It has taken so far approximately 400 man-hours to dispute this claim. The dispute started in October 1999, and it is not yet resolved. If this happens once per year among the three AFBs, the cost to the government would be = 400*$75 = $30,000, assuming the Government doesn't have to pay for any labor or materials.
Annual Cost = $30,000
District-Wide = $66,000

Lesson # 32: Drawing Scale Error.

This problem has been happening two times per year for the last several years for the three AFBs. As a consequence of the scaling, modifications had to be written on site for utility lines. This modification cost 6 hours at $75, plus the 35% of materials and labor of $10,000.
Cost of this incident = 6*$75 + 0.35*$10,000 = $3,950
Yearly Savings = 2*$3,950 = $7,900
District-Wide = 2.2*$7,900 = $17,380

Lesson # 34. Malmstrom AFB, MT Underground High Temp HW Distribution System:

At Malmstrom Air Force base there is an underground high temp hot water distribution system for the whole base. The existing high temperature hot water (HTHW) distribution system throughout the base is not a direct burial system but rather a system distributed inside buried concrete tunnels/vaults. The top of the vault is approximately 2 feet below grade and the bottom up to 6 to 7 feet below grade. On many designs, new utilities are shown passing over or in the vicinity of these HTHW lines, and the designers simply assume they are direct-buried pipes which can easily be passed over or under. This is a base-specific item but a continuing problem with most designs at that base. There have been between 7 and 8 cases of contract modifications because of this in the last 3 years. The average cost of this modification has been around $10,000. This type of knowledge can only reside in a local CLL system.
Cost avoided yearly = (7.5/3) * ($10,000) = $25,000

Lesson # 35: Building Entrance Sleeve.

The issue contemplated in this lesson has resulted in some delays but not in any extra cost. Learning this lesson improves the final quality and also the coordination between contractor and subs.

Lesson #36: Deflection Detail for top of Gypsumboard walls.

This problem happens 4 or 5 times per year at three AFBs. The time to write a modification is 6 man-hours or 6*75 = $450. The cost of labor and materials for the contract modification is $3,500 per building. 35% of that is $1,225.
Total yearly cost for 3 AFBs is 4.5*(450+$1,225) = $7,537.
District-Wide = $16,583

Lesson #37: Verification of existing water pressures and flows.

This happened 4 times in the last two years.

> One time the modification took 40 man-hour and a $22,000 pumping station was added. Cost is (40*75) + ($22,000) = $25,000
>
> Two other times the designer had to go back to the customer to ask for a waiver of requirement. It resulted in a lower quality and lower safety standard for the product.
>
> Another time the modification took 40 man-hours and resulted in increasing the size of the waterline to the building at $7,000. Total cost is (40*75) + 7,000 = $10,000.

Total Yearly cost saved in this part of the district is 0.5*($25,000 + $10,000) = $17,500
District-Wide = $38,500

In addition, the lesson would significantly increase the quality of the final product since the two occurrences before this lesson the buildings did not meet the requirements of the customer.

Lesson # 38: Water Flow Alarms, Electric Vs Water Motor

This is a local issue, and it is mainly due to local preferences of different fire departments. It happened 5 times last year with a cost of 10 person-hours and $1,500 additional cost. Contingency Cost was 10*$75 + $1,500 = $2,250. The Yearly Cost was 5*$2,250 = $11,250
It is a local issue.

Lesson #39: Independent Building Commissioning Requirement.

In this case the cost of commissioning is added to the original contract. As a consequence, there are fewer calls from customers requesting reviews of performance. Before adding this requirement there were between 2 and 3 callback responses during the warranty period for each building. Each call took 2 to 4 hours to answer and there were around 15 buildings per year at 3 AFBs.
Cost of one contingency is 2.5 *3* $75 = $562
Yearly Cost is $562*15 = $8,438.
District-Wide = $18,562

Lesson #41: Lead Based Paint Abatement Surveys and Quantities.

There have been two cases of this in the last year in the 3 AFBs. It took between 20 and 30 man-hours to analyze the modification, and the modification cost $35,000. The total yearly cost saved with this lesson is: 2*[(25*$75) + (0.35*$35,000)] = $28,250.
Cost of this contingency = $14,125
District-Wide = 2.2*$28,250 = 62,150

Lesson #42: Room Signage

This lesson has to do with confusion created for the lack of consistency between room numbers during the different phases of the design and construction process. There is not any specific case of contract modification caused by this, although there is a number of hours wasted every year due to this.

Lesson #45: Separate Ground Conductors for Dryers and Ranges.

This issue caused 3 contract modifications in the last 2 years. The cost of labor & materials was $1,000 for each modification, and time to analyze and write the modification was 10 hours.
Contingency cost = 1,000
Total annual savings from lesson = (3/2) * (10*75+0.35* $1,000) = $1,600.
District-Wide = 2.2*$1,600 = $3,630

Lesson #50: Thickness of Joint Sealant

This issue produced a major failure of the airfield at Mosses Lake, Washington. Because of this deficiency, the contractor was forced to remove 40,000 linear feet of sealant in this field. The Corps had to use 100 additional man-hours to inspect the removal and the application of the new one. In addition, the airfield was out of commission for more than two weeks. As a consequence, the customer was highly unsatisfied. This happened in the summer of 2000, during a Short Field Assault Strip Training.

Due to the failure of the sealant the Lake Mosses Air Field was not ready for training. The training was not moved to any other place because there is not another site available for Short Strip Assault Landing training. Four or five pilots were not current in this skill because they missed their training. There is no way to estimate the cost of that lack of training to the Air Force. However, the impact to the mission was major.
Cost to the Corps = 75*100= $7500
District-Wide = $16,500
Cost to the Air Force = Non-quantifiable.

Lesson #51: QC/QA of As-Design electronic Files:

This issue caused two claims in the last half year and both claims resulted in contract modifications. Estimated occurrence of four times per year. The modifications required the contractor to do extra work in finishing the drawing for the Corps. One modification was $7000 and the other was $4,000. Total semi-annual savings for future is: 2*10 Hours of Claims at $75 and 2* 30 Hours of Modifications at $75, plus $11,000 of Modifications = $17,000 per half year.
Total annual cost is $8,500 per Occurrence * 4 Occurrences/Year = $34,000.
District-Wide = 2.2*$34,000 = $74,800

Lesson #52: Sprinkler Branch Line Restraints.

This is an issue of compliance with seismic design guide. Failure to comply may result in a safety hazard. This has resulted in 5 to 6 contract modifications per year for the 3 AFBs of this area. Each modification took 10 person-hours to produce.
Annual cost avoided = 5.5*$75*10 = $4,125.
Expected Savings District Wide = 2.2*4,125= $9,075

Lesson #53: Items to Mandate in Construction Project Schedules.

This is another Best Practice lesson. There is not a specific modification or dispute behind it, but following this lesson saves time and headaches down the road. This practice avoids project delays by modifying process. As a consequence, quality and customer satisfaction improves considerably.
Non-Quantifiable Benefits (NQB)

Lesson #54: Repetitive Problems-Pipe and Duct Sleeves.

This is a Best Practice Lesson and does not have any specific cost associated with it although it improves the quality of the final product considerably and avoids delays and misunderstandings.
Non-Quantifiable Benefits (NQB)

Lesson #55: Cathodic Protection of Standpipes and Reservoirs.

This lesson comes from 5 incidents in the last 3 years. It has to do with the fact the cathodic protection requires electrical continuity of the structure protected. Bolted tanks do not offer the degree of electrical continuity required. It took 400 person-hours to resolve all the communication problems due to the fact that no one wants to take responsibilities for the problem with bolted tanks with cathodic protection.
Yearly cost = (5/3)*(400*$75) = $50,000
District-Wide = $110,000

Lesson # 57: Horizontal Pipe Support Repetitive Problem.

This is also another “Best Practice” lesson that impacts the quality of the product.

Lesson #58: Support and Sway Bracing for Plastic Piping.

Another Best Practice lesson.

Lesson #59: HVAC Ductwork Design Obligations.

This issue has resulted in two contract modifications during last year. The cost of labor and material for them was $5,000, and they took approximately 10 person-hour to write the mod.
Cost of Contingency = 10*75 + .35*5,000= $2,500
Estimated annual cost = 2*(10*$75 + 35%*5000) = 5,000
District-Wide = $11,000

Lesson #60: Masonry Sealer.

There have been 4 contract modifications with this topic last year. Each modification was $4,000 and took 10 person-hour to process.
Contingency Cost = $2,150
Total annual cost = 4*[(10*$75)+(35%* $4000)] = $8,600
District-Wide = $18,920.

Lesson #61: Malmstrom AFB – Fire protection Rotating Red Beacon.

This is a local issue with this installation. As a consequence, these kind of lessons cannot be put into Corps-wide design guides. This has resulted in 4 contract modifications last two years. The cost of the modification was $1,000 and took 10 person-hours to process.
Contingency Cost = (10*$75) + $1000 = $1,750
Annual cost Avoided= 2*(10*$75 + $1000) = $3,500

Lesson # 62: Flashing Exit Signs during Fire Alarm.

This lesson comes from an Americans with Disabilities Act (ADA) and a UFAS requirement. There have been 5 cases last year that resulted in a $7,500 contract modification and required 80 person-hours to resolve.
Annual cost avoided = 5 * [(35%*$7,500) + (80*$75)] = $43,125
District-Wide = $94,875

Lesson # 64: Water meter Without DDC Output.

This occurred 2 times last year, and each time resulted in a small contract modification of $400. The time to write the modification was estimated to be 10 person-hours.
Yearly Average cost avoided = 2*($400 + $750) = $2,300
Expected savings District-Wide = 2.2*$2,300 = $5.060

Lesson # 67: Backflow Prevention.

This instance tends to happen once per year. In some cases the contractor may have to add a floor drain if not provided. It takes 10 person-hours and $150 of extra labor and material to resolve this kind of modification.
Cost of this instance = $75*10 + $150 = $900
District-Wide = $1,980

Lesson # 71: 400 Hertz Frequency Converters.

This lesson comes from the fact that these converters are Government-Furnished-Contractor-Installed (GFCI) and there are coordination problems that result in delays and extra cost. In Mt Home AFB there have been 4 incidents in the last 3 years. It took 200 person-hours per incident to resolve this. McChord AFB may have similar problem.
Yearly cost avoided = (4/3)*(200*$75) = $20,000
District-Wide = $44,000

Lesson #74, Integrally colored sidewalks:

This incident happened one time, and it is estimate to possibly occur once per year. It is a local issue with the color coordination of paths. The quality of the sidewalk was unacceptable. The cost of remediation was estimated to be $25,000. A compromise was reached to solve it for $8,000 instead. The cost of evaluating the problem was estimated as $750, and the cost of disputing the remedy with contractor and customer was $1,775. The total estimated cost is $10,525. With the lesson stored and distributed, this cost will be avoided yearly. Avoiding this problem results in a higher quality product
District-Wide Cost = $23,155

APPENDIX C: ECONPACK Output for CLL Phase 1

DATE GENERATED: 12 Jan 2001
TIME GENERATED: 16:43:40
VERSION: ECONPACK 2.0

CLL
ECONOMIC ANALYSIS

EXECUTIVE SUMMARY REPORT

PROJECT TITLE : Corporate Lessons Learned
DISCOUNT RATE : 4%
PERIOD OF ANALYSIS : 7 Years
START YEAR : 1999
BASE YEAR : 2000
REPORT OUTPUT : Constant Dollars

PROJECT OBJECTIVE : The objective of the CLL project is to provide the USACE with a system architecture able to support the different knowledge transfers necessary

ECONOMIC INDICATORS:

ALTERNATIVE NAME	NPV	SIR	DPP	BIR
1 Integrated CLL	$148,272	120.4	2.0 YEARS	N/A
2 Status Quo	$2,932,918	N/A	N/A	N/A

ACTION OFFICER : Jeffrey Kirby
ORGANIZATION : USA-ARDC-CF, N

LIFE CYCLE COST REPORT

1 Integrated CLL

YEAR	Initial Software Development (1)	Initial Training (2)	Initial Annual Fee (3)	Initial System Adm (4)	Initial Lesson Evaluation (5)
1999	$5,000	$0	$0	$0	$0
2000	$0	$750	$3,125	$10,800	$3,900
2001	$0	$0	$0	$0	$0
2002	$0	$0	$0	$0	$0
2003	$0	$0	$0	$0	$0
2004	$0	$0	$0	$0	$0
2005	$0	$0	$0	$0	$0
%NPV	3.44	0.50	2.07	7.14	2.58
	$5,099	$735	$3,064	$10,590	$3,824
DISCOUNTING CONVENTION	M-O-Y	M-O-Y	M-O-Y	M-O-Y	M-O-Y
INFLATION INDEX	No Inflation	No Inflation	No Inflation	No Inflation	No Inflation

LIFE CYCLE COST REPORT

1 Integrated CLL

YEAR	Recurrent Annual Fee (6)	Recurrent System Adm. (7)	Recurrent Lesson Evaluation (8)	Recurrent Annual Training (9)	TOTAL ANNUAL OUTLAYS
1999	$0	$0	$0	$0	$5,000
2000	$0	$0	$0	$0	$18,575
2001	$3,125	$10,800	$3,900	$10,800	$28,625
2002	$3,125	$10,800	$3,900	$10,800	$28,625
2003	$3,125	$10,800	$3,900	$10,800	$28,625
2004	$3,125	$10,800	$3,900	$10,800	$28,625
2005	$3,125	$10,800	$3,900	$10,800	$28,625
%NPV	9.20	31.80	11.48	31.80	
	$13,642	$47,146	$17,025	$47,146	
DISCOUNTING CONVENTION	M-O-Y	M-O-Y	M-O-Y	M-O-Y	
INFLATION INDEX	No Inflation	No Inflation	No Inflation	No Inflation	

LIFE CYCLE COST REPORT

1 Integrated CLL

YEAR	MIDDLE OF YEAR DISCOUNT FACTORS	PRESENT VALUE	CUMULATIVE NET PRESENT VALUE
----	--------------	--------------	--------------
1999	1.020	$5,099	$5,099
2000	0.981	$18,214	$23,313
2001	0.943	$26,990	$50,303
2002	0.907	$25,951	$76,254
2003	0.872	$24,953	$101,208
2004	0.838	$23,994	$125,201
2005	0.806	$23,071	$148,272

4% DISCOUNT RATE, 7 YEARS

PRIMARY ECONOMIC ANALYSIS

Status Quo Alternative: Status Quo
Proposed Alternative : Integrated CLL

Project Year(s)	Recurring Annual Operating Costs Status Quo Alternative	Proposed Alternative	Present Differential Costs	Value of Value Factor	Present Differential Costs
1999	$0	$0	$0	1.020	$0
2000	$0	$0	$0	0.981	$0
2001	$671,860	$28,625	$643,235	0.943	$606,484
2002	$671,860	$28,625	$643,235	0.907	$583,158
2003	$671,860	$28,625	$643,235	0.872	$560,729
2004	$671,860	$28,625	$643,235	0.838	$539,162
2005	$671,860	$28,625	$643,235	0.806	$518,425
Totals	$3,359,300	$143,125	$3,216,175		$2,807,959

PRIMARY ECONOMIC ANALYSIS

Total present value of investment	$23,313
Plus: present value of existing assets to be used	$0
Less: present value of existing assets replaced	$0
Less: present value of proposed alternative salvage value	$0
Total present value of net investment	$23,313
Total present value of differential costs	$2,807,959
Plus: present value of status quo investment costs eliminated	$0
Less: present value of status quo salvage value	$0
Total present value of savings	$2,807,959
Savings/Investment Ratio	120.4
Discounted Payback Period	2. Years

For Status Quo:

Recurring Costs - Expense Item(s) 1

For Proposed Alternative:

Recurring Costs - Expense Item(s)	6	7	8	9	
Investment Costs - Expense Item(s)	1	2	3	4	5

LIFE CYCLE COST REPORT

2 Status Quo

YEAR	Contingencies Cost (1)	TOTAL ANNUAL OUTLAYS	MIDDLE OF YEAR DISCOUNT FACTORS	PRESENT VALUE	CUMULATIVE NET PRESENT VALUE
----	--------------	--------------	--------------	--------------	--------------
1999	$0	$0	1.020	$0	$0
2000	$0	$0	0.981	$0	$0
2001	$671,860	$671,860	0.943	$633,474	$633,474
2002	$671,860	$671,860	0.907	$609,110	$1,242,584
2003	$671,860	$671,860	0.872	$585,682	$1,828,266
2004	$671,860	$671,860	0.838	$563,156	$2,391,422
2005	$671,860	$671,860	0.806	$541,496	$2,932,918

%NPV	100.00				
	$2,932,918				
DISCOUNTING CONVENTION	M-O-Y				
INFLATION INDEX	No Inflation				

4% DISCOUNT RATE, 7 YEARS

COST SENSITIVITY ANALYSIS 1

TITLE: CSA1

This sensitivity analysis checks for alternative 2 to be ranked least cost as a result of changes in the expense item(s) listed below:

ALTERNATIVE		EXPENSE ITEM(S)
2	Status Quo	1 Contingencies Cost
1	Integrated CLL	** NOTHING CHANGED **

The selected expense items are allowed to vary from a value of -100.00% to 200.00%

ALTERNATIVE		NET PRESENT VALUE
1	Integrated CLL	$148,272
2	Status Quo	$2,932,918

RESULTS:

For alternative 2 to be ranked least cost, reduce the selected expense item(s) by more than 94.94%.

APPENDIX D: ECONPACK Output for CLL Phase 2

DATE GENERATED: 12 Jan 2001
TIME GENERATED: 16:51:08
VERSION: ECONPACK 2.0

CLLPhase2
ECONOMIC ANALYSIS

EXECUTIVE SUMMARY REPORT

PROJECT TITLE : Corporate Lessons Learned Phase 2
DISCOUNT RATE : 4%
PERIOD OF ANALYSIS : 7 Years
START YEAR : 2001
BASE YEAR : 2001
REPORT OUTPUT : Current Dollars

PROJECT OBJECTIVE : To provide the UASCE with a system architecture able to support the different knowledge transfers necessary for its mission.

ECONOMIC INDICATORS:

ALTERNATIVE NAME	NPV	SIR	DPP	BIR
1 CLL Phase 2	$2,205,359	140.5	2.0 YEARS	N/A
2 Status Quo	$54,567,137	N/A	N/A	N/A

ACTION OFFICER : Jeffrey Kirby
ORGANIZATION : USACERL

LIFE CYCLE COST REPORT

1 CLL Phase 2

YEAR	Software Development (1)	Hardware (2)	Software (3)	Initial Training (4)	Annual System Adm. (5)
2001	$165,000	$20,000	$10,000	$5,000	$0
2002	$175,000	$10,000	$5,000	$0	$0
2003	$0	$0	$0	$0	$118,000
2004	$0	$0	$0	$0	$118,000
2005	$0	$0	$0	$0	$118,000
2006	$0	$0	$0	$0	$118,000
2007	$0	$0	$0	$0	$118,000
%NPV	14.82	1.32	0.66	0.22	22.46
	$326,797	$29,040	$14,520	$4,903	$495,302
DISCOUNTING CONVENTION	M-O-Y	M-O-Y	M-O-Y	M-O-Y	M-O-Y
INFLATION INDEX	No Inflation	No Inflation	No Inflation	No Inflation	No Inflation

LIFE CYCLE COST REPORT

1 CLL Phase 2

YEAR	Annual Fee (6)	Annual Training (7)	TOTAL ANNUAL OUTLAYS	MIDDLE OF YEAR DISCOUNT FACTORS	PRESENT VALUE
----	--------------	--------------	--------------	--------------	--------------
2001	$0	$0	$200,000	0.981	$196,116
2002	$0	$0	$190,000	0.943	$179,145
2003	$200,000	$118,000	$436,000	0.907	$395,278
2004	$200,000	$118,000	$436,000	0.872	$380,075
2005	$200,000	$118,000	$436,000	0.838	$365,457
2006	$200,000	$118,000	$436,000	0.806	$351,401
2007	$200,000	$118,000	$436,000	0.775	$337,886
	--------------	--------------			
%NPV	38.07	22.46			
	$839,494	$495,302			
DISCOUNTING CONVENTION	M-O-Y	M-O-Y			
INFLATION INDEX	No Inflation	No Inflation			

LIFE CYCLE COST REPORT

1 CLL Phase 2

YEAR	CUMULATIVE NET PRESENT VALUE
----	--------------
2001	$196,116
2002	$375,261
2003	$770,539
2004	$1,150,615
2005	$1,516,072
2006	$1,867,473
2007	$2,205,359

4% DISCOUNT RATE, 7 YEARS

PRIMARY ECONOMIC ANALYSIS

Status Quo Alternative: Status Quo
Proposed Alternative : CLL Phase 2

Project Year(s)	Recurring Annual Operating Costs Status Quo Alternative	Proposed Alternative	Present Differential Costs	Value of Value Factor	Present Differential Costs
2001	$0	$0	$0	0.981	$0
2002	$0	$0	$0	0.943	$0
2003	$13,000,000	$436,000	$12,564,000	0.907	$11,390,547
2004	$13,000,000	$436,000	$12,564,000	0.872	$10,952,449
2005	$13,000,000	$436,000	$12,564,000	0.838	$10,531,201
2006	$13,000,000	$436,000	$12,564,000	0.806	$10,126,155
2007	$13,000,000	$436,000	$12,564,000	0.775	$9,736,687
Totals	$65,000,000	$2,180,000	$62,820,000		$52,737,039

PRIMARY ECONOMIC ANALYSIS

Total present value of investment		$375,261	
Plus: present value of existing assets to be used			$0
Less: present value of existing assets replaced		$0	
Less: present value of proposed alternative salvage value		$0	
Total present value of net investment		$375,261	
Total present value of differential costs		$52,737,039	
Plus: present value of status quo investment costs eliminated		$0	
Less: present value of status quo salvage value			$0
Total present value of savings		$52,737,039	
Savings/Investment Ratio	140.5		
Discounted Payback Period		2. Years	

For Status Quo:

Recurring Costs - Expense Item(s)	1			

For Proposed Alternative:

Recurring Costs - Expense Item(s)	5	6	7	
Investment Costs - Expense Item(s)	1	2	3	4

LIFE CYCLE COST REPORT

2 Status Quo

YEAR	Contingency Cost (1)	TOTAL ANNUAL OUTLAYS	MIDDLE OF YEAR DISCOUNT FACTORS	PRESENT VALUE	CUMULATIVE NET PRESENT VALUE
----	--------------	--------------	--------------	--------------	--------------
2001	$0	$0	0.981	$0	$0
2002	$0	$0	0.943	$0	$0
2003	$13,000,000	$13,000,000	0.907	$11,785,825	$11,785,825
2004	$13,000,000	$13,000,000	0.872	$11,332,524	$23,118,350
2005	$13,000,000	$13,000,000	0.838	$10,896,658	$34,015,008
2006	$13,000,000	$13,000,000	0.806	$10,477,556	$44,492,564
2007	$13,000,000	$13,000,000	0.775	$10,074,573	$54,567,137

%NPV	100.00				
	$54,567,137				
DISCOUNTING CONVENTION	M-O-Y				
INFLATION INDEX	No Inflation				

4% DISCOUNT RATE, 7 YEARS

COST SENSITIVITY ANALYSIS 1

TITLE: Cost Sensitivity Analysis for CLL Phase 2

This sensitivity analysis checks for alternative 2 to be ranked least cost as a result of changes in the expense item(s) listed below:

ALTERNATIVE	EXPENSE ITEM(S)
2 Status Quo	1 Contingency Cost
1 CLL Phase 2	1 Software Development

The selected expense items are allowed to vary from a value of -100.00% to 200.00%

ALTERNATIVE	NET PRESENT VALUE
1 CLL Phase 2	$2,205,359
2 Status Quo	$54,567,137

RESULTS:

COST SENSITIVITY ANALYSIS 1

TABLE OF PERCENT CHANGES WHERE ALTERNATIVES' NPVs ARE EQUAL

% CHANGE OF SELECTED EXPENSE ITEMS FOR CLL Phase 2 (INITIALLY LEAST COST)	% CHANGE OF SELECTED EXPENSE ITEMS FOR Status Quo (INITIALLY HIGHER COST)	NET PRESENT VALUE
-100.00	-96.56	$1,878,561
-88.00	-96.49	$1,917,777
-76.00	-96.41	$1,956,993
-64.00	-96.34	$1,996,208
-52.00	-96.27	$2,035,424
-40.00	-96.20	$2,074,640
-28.00	-96.13	$2,113,855
-16.00	-96.05	$2,153,071
-4.00	-95.98	$2,192,287
8.00	-95.91	$2,231,502
20.00	-95.84	$2,270,718
32.00	-95.77	$2,309,934
44.00	-95.69	$2,349,149
56.00	-95.62	$2,388,365
68.00	-95.55	$2,427,581
80.00	-95.48	$2,466,796
92.00	-95.41	$2,506,012
104.00	-95.34	$2,545,228
116.00	-95.26	$2,584,443
128.00	-95.19	$2,623,659
140.00	-95.12	$2,662,875
152.00	-95.05	$2,702,091
164.00	-94.98	$2,741,306
176.00	-94.90	$2,780,522
188.00	-94.83	$2,819,738
200.00	-94.76	$2,858,953

EXPLANATION OF TABLE USE: FOR ANY NUMBER IN THE FIRST COLUMN, RANKING REVERSAL WILL OCCUR IF THE CHANGE IN EXPENSE ITEM(S) FOR THE OTHER ALTERNATIVE FALLS IN THE RANGE OF -100% TO THE CORRESPONDING NUMBER IN THE SECOND COLUMN. FOR EXAMPLE: FOR A CHANGE OF 44% IN THE SELECTED EXPENSE ITEMS OF CLL Phase 2, ANY % CHANGE IN THE SELECTED EXPENSE ITEMS OF Status Quo IN THE RANGE OF -100% TO -95.69% WILL RESULT IN Status Quo HAVING AN NPV LESS THAN THAT OF CLL Phase 2.

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3/01

REPORT DOCUMENTATION PAGE

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14. ABSTRACT

When approved, the completion of the CLL development effort will provide the Corps of Engineers with a corporate level method to capture, review, approve, and reuse lessons learned across a variety of legacy information systems as well as have this capability to incorporated within future ISs. The financial importance of a corporate wide approach to lessons learned is clearly shown in the attached Economic Analysis. Lessons already generated with the first Design Quality application using a prototype CLL are estimated to save Seattle District $2.8M over the next seven (7) years. By making these lessons available to the entire Corps with a completed CLL, anticipated saving on these lessons will grow to $52.8M over the next seven (7) years.

The Engineer Research and Development Center (ERDC), Construction Engineering Research Laboratory (CERL) has submitted this LCMIS documentation for the Corporate Lessons Learned (CLL) System to satisfy a combined Milestone 1 (Demonstration and Validation Phase) and Milestone 2 (Development Phase) of CLL.

15. SUBJECT TERMS
Automated Information Systems (AIS); cost analysis; Life Cycle Management Information Systems (LCMIS); Corporate Lessons Learned (CLL); economic analysis (EA); Knowledge Management (KM)

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